

Chapter 3: Maryland's Wildlife Resources and Species of Greatest Conservation Need (GCN)

Distribution and Abundance

The state's physiographic gradient and associated regional climatic differences provide the distribution framework for its wildlife species. Some common wildlife species are distributed throughout the state as part of Maryland's typical fauna. Others, however, are limited to specific areas of the state. For example, Appalachian Mountain species, such as the Alleghany woodrat, are limited to the western part of the state. Estuarine species like oysters and blue crab are found only in the Chesapeake Bay or the Coastal Bays. Whales and bluefin tuna are limited to the marine waters of the Atlantic Ocean and piping plovers nest on the beaches of Assateague Island. The pearl dace and checkered sculpin are examples of fish species found in Maryland's Great Valley, with most of the world's population of the checkered sculpin found in Maryland.

Table 3.1 summarizes the state, federal, and global listings and abundance ranks for Maryland's species by taxa. For additional regional, national, and international ranks see Appendix 3a and 3b. Each taxa group is discussed further in the next sections. The species ranks assigned and maintained by the Wildlife and Heritage Service's Natural Heritage Program (NHP) are the most complete list and accounting of wildlife species abundance status in Maryland (Appendix 3a). Data maintained by NHP represents the best available summary of information on the abundance, distribution and status of wildlife species for the state, and these data were reviewed as one of the initial steps to determine which species are in the greatest need of conservation.

Table 3.1 Wildlife Diversity of Maryland

Taxa	Total¹	State-listed²	Federally-listed	S1 - S3 Ranked	G1 – G3 Ranked³	GCN
Mammals	97	24	10	18	11	34
Birds	410	33	6	127	8	141
Herpetofauna	90	20	6	23	8	42
Fishes	635	26	2	28	3	40
Invertebrates	20,000+	58	5	205	62	245
Total		161	29	401	92	502

¹Includes accidentals and species ranked by NHP as SP (Potentially occurs in the state); does not include subspecies or species with State Rank of SRF (Reported falsely: Erroneously reported in the state and the error has persisted in the literature), or SE (Exotic: An exotic established in the state; may be native in nearby regions).

²Number of state-listed species includes some, but not all that are listed in COMAR 08.02.12 due to taxonomic group listing (e.g., sharks).

³Global ranks are maintained by NatureServe; 2003 data were used for this document.

Key: S1 = Critically imperiled in the state
 S2 = Imperiled in the state
 S3 = Rare to uncommon and potentially vulnerable to extirpation within in the state
 G1 = Critically imperiled across its entire range (i.e., globally)
 G2 = Imperiled across its entire range (i.e., globally)
 G3 = Rare across its entire range (i.e., globally) or distributed locally in a restricted range
 GCN = Species of Greatest Conservation Need

Species of Greatest Conservation Need (GCN)

This Wildlife Diversity Conservation Plan development process provided DNR the opportunity to identify species of wildlife in greatest need of conservation, as well as the key habitats that support them. Rather than focusing on a certain group or category of wildlife, this effort evaluated the status of over 2,000 known animal species and considered the countless thousands more of additional invertebrate species yet unnamed and unstudied in Maryland. By considering all species in this assessment, the broader interrelationships of wildlife conservation could be addressed. While it is clear that the rarest (threatened and endangered species) are in need of conservation, it is also clear that other declining or vulnerable species need attention. By considering these additional factors, as well as the national guidance criteria (described below), over 500 species, like the least brook lamprey, cerulean warbler, southern pygmy shrew, and the rapids clubtail, were determined to be in greatest need of conservation (Appendix 3b). These are species at risk of disappearing from Maryland in the foreseeable future if appropriate conservation actions are not implemented.

The Maryland Wildlife Diversity Conservation Plan process for identification of Species of Greatest Conservation Need (GCN) within each of the wildlife taxa groups involved collection and compilation of the best available quantitative and qualitative input from agency staff and stakeholders, including: Wildlife and Heritage Service, Fisheries Service, Maryland Biological Stream Survey, university and non-profit organization partners, and scientific experts (Appendix 1a). Using national guidance and the best scientific information available, each species status was assessed to determine those in greatest need of conservation. The criteria that were used during the assessment process and to ultimately identify these species were adopted from national guidelines developed by the International Association of Fish and Wildlife Agencies (IAFWA) and the U.S. Fish and Wildlife Service (USFWS) (Table 3.2). Numerous existing state, regional, and national ranking systems that prioritized or ranked species for each wildlife taxa group were used as a foundation for this process, including: Natural Heritage Program (NHP) and NatureServe's State and Global Ranks, The Nature Conservancy (TNC) ecoregional target species, USFWS and National Marine Fisheries Service (NMFS), indicator species from the Maryland Biological Stream Survey (MBSS), regional species of concern from the Northeast Technical Committee of the Association of Fish and Wildlife Agencies, USFWS Birds of Conservation Concern, Partners in Flight (PIF) Bird Conservation Plan priority species, DNR Fisheries Service, and American Fisheries Society's species of concern (Table 3.3). The overlap of priorities among groups, stakeholders, experts and agencies indicated significant agreement.

Table 3.2 IAFWA National Guidance Committee Criteria for GCN Species Assessment

- Endangered, threatened and candidate species (federal or state)
- Imperiled species (globally rare)
- Declining species
- Endemic species
- Disjunct species
- Vulnerable species
- Species with small, localized “at-risk” populations
- Species with limited dispersal
- Species with fragmented or isolated populations
- Species of special, or conservation, concern
- Focal species
(keystone species, wide-ranging species, species with specific needs)
- Indicator species
- “Responsibility” species
(i.e. species that have their center of range within a state)
- Species that aggregate in concentration areas
(e.g. migratory stopover sites, bat roosts / maternity sites)

Some species groups, especially among invertebrates, have received little scientific study compared to others. Thus the list of rare and declining invertebrates is fairly well established for some groups, such as butterflies, dragonflies and damselflies, and freshwater mussels; however, it is known to be inadequate for many others, including most insects. This Plan is using the Key Wildlife Habitats and natural communities as a coarse-filter or umbrella to accommodate this lack of knowledge and to provide some level of conservation for these little-known species. This more holistic approach of focusing on habitats and natural communities will proactively provide conservation to these GCN species, as well as the entire spectrum of wildlife from rare to abundant.

DNR’s Wildlife and Heritage Service, MBSS, and Fisheries Service staff provided information on species’ status, abundance, distribution, and habitat associations. Individuals who are recognized in their field and represent many of the major universities and conservation organizations active in conserving these species in Maryland added their input to DNR. Staff and stakeholder input from surveys and workshops helped refine the resulting list of these species of GCN.

Table 3.3 Categories used for inclusion on Maryland's list of Wildlife Species of Greatest Conservation Need (GCN)

- Federally-listed threatened and endangered animals
- State-listed threatened and endangered animals
- Wildlife species listed as In Need of Conservation
- Natural Heritage Program tracked and watchlist animal species
- Northeast wildlife species of regional conservation concern
- Endemic species
- Responsibility species (those for which MD supports the core populations)
- Partners in Flight and All Bird Conservation priority species
- US Fish & Wildlife Service's migratory birds of management concern
- Colonial waterbirds
- Forest interior breeding birds
- Shrubland successional breeding birds at risk
- Grassland breeding birds at risk
- Shorebirds with significant migratory concentrations
- Marshland breeding birds (e.g., rails, bitterns, sedge wren) at risk
- Reptiles and amphibians at risk
- Bats at risk
- Small mammals at risk
- Terrestrial and aquatic invertebrates at risk
- Freshwater fish at risk
- American Fisheries Society's species of concern
- Depleted anadromous fish (e.g., shad spp., sturgeon)
- Depleted marine invertebrates (e.g., horseshoe crab)
- Sensitive aquatic species

Mammals of Maryland

Whitaker and Hamilton (1998) list 121 species of mammals native to, or currently established, in the eastern United States. Specifically to Maryland, Paradiso (1969) lists 64 land mammals, including introduced species, and 10 marine mammals, plus six species that have been extirpated since 1600. The Smithsonian Book of North American Mammals (Wilson and Ruff 1999) records 89 species of native mammals, including 26 species of marine mammals, as occurring in Maryland. These sources of information on mammals in Maryland present differing or incomplete views on numbers of mammal species found in the state. Although there may never be a final authority or consensus regarding the exact number

of species, this Wildlife Diversity Conservation Plan (WDCP) is a tool and an ongoing mechanism to track the current abundance and distribution of species in greatest need of conservation in Maryland.

The Natural Heritage Program (NHP) database includes 97 native mammals as residents, migrants, accidental visitors, or species that are very likely to occur in the state, including 28 marine mammals and 7 historical or extirpated species. All together, NHP database lists 75 land mammals in Maryland including native and introduced species. These 75 include 12 shrews and moles, 11 bats, 3 rabbits and hares, 26 rodents, 17 carnivores, 2 deer, and the Assateague pony. Much of the mammal diversity of the state can be attributed to the four western counties, with 21 species found exclusively in or near these counties. By contrast, only the Delmarva fox squirrel, sika deer, and Assateague pony are restricted to the Coastal Plain; the latter two being introduced species. Thus, most of Maryland's mammals have statewide distributions.

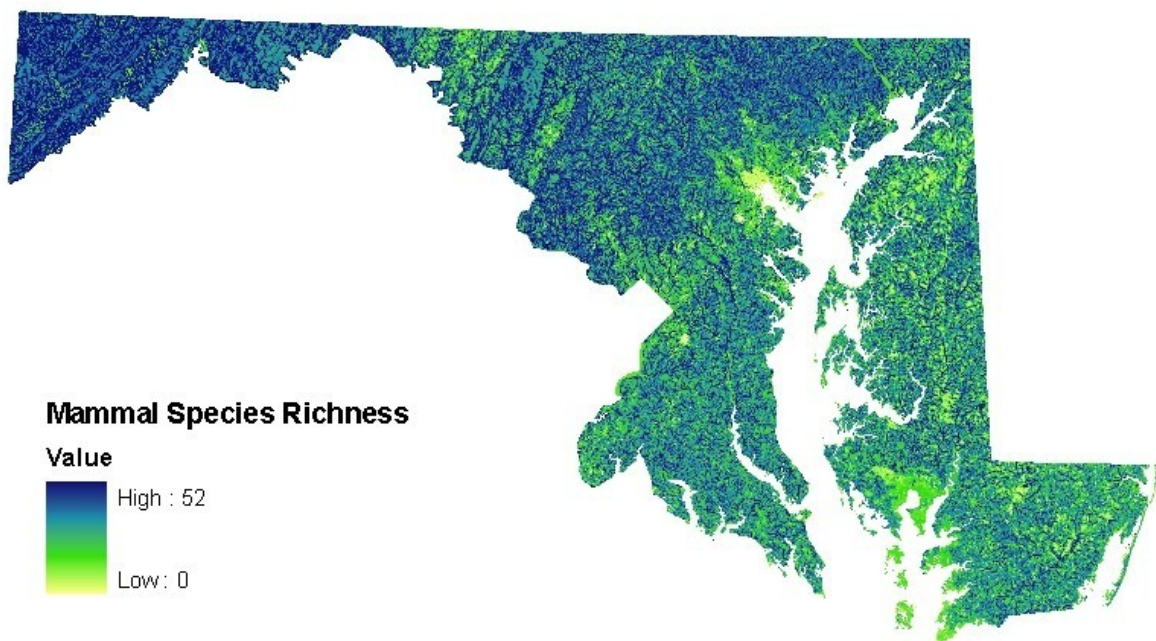
Exotic species of mammals have become established in Maryland either through intentional or unintentional introductions. Three rodents arrived in Maryland with the earliest waves of Europeans to the Americas: house mouse, Norway rat and black rat. Sika deer, released in Maryland on James Island in 1916 and on Assateague Island about 1930, have increased greatly and now occupy four counties on Maryland's Eastern Shore (Whitaker and Hamilton 1998). Nutria, a 15-20 lb rodent of South American origins, have displaced the native muskrat in many marshes of the Eastern Shore. Able to breed throughout the year and sometimes "eating out" marsh vegetation, nutria greatly alter the marsh ecosystem and are currently a nuisance. An aggressive nutria eradication program is currently underway on the Eastern Shore.

Several species of mammals in Maryland are game animals with legal hunting or trapping seasons. DNR's Wildlife and Heritage Service has several programs that monitor the current status of game species, including deer, bears, small game, and furbearers. The deer management program monitors abundance and distribution in the state and regulates deer-hunting seasons to maintain healthy deer populations within biological and cultural carrying capacities. A deer management plan (MD DNR1998) was developed by DNR. During the past 15 years, deer populations have doubled or more in most counties, even increased 5-7 times in some counties. The four western counties have high population densities (and the lowest rates of increase in the past 15 years), the highest deer yields, and the lowest ratios of fawns per adult doe, perhaps indicating population densities near carrying capacity. By contrast, eastern counties have more greatly expanding populations and much higher ratios of fawns per adult does. Even with the increased taking of antlerless deer, the state's deer population continues to expand.

Black bear populations have increased in western Maryland over the past 20 years. A black bear management plan (MD DNR 2004a) was developed recently by DNR. Black bear populations have been monitored since the 1980s using a variety of techniques. Most of Maryland's estimated 400-500 bears are in the four western counties. In an effort to curb the expanding population and with public support, a limited hunt was initiated in 2004 and 20 bears were harvested on the first day.

The furbearer management program involves research to monitor population levels of 14 species and to obtain biological information for mammal species currently or historically harvested for fur, including foxes, muskrats, beavers, and raccoons. Otters and fishers have become established within their historical ranges and coyotes are now present throughout Maryland. Trappers have taken an average of 240 otters annually for the past 8 years; the first fishers were taken in 1977-1978, and trappers have taken an average of 14 fishers a year for the past 6 years. Associated management and outreach activities include resolving conflicts when population numbers increase in public areas and sometimes result in human-wildlife conflicts.

Figure 3.1 Distribution of Maryland's Mammals (Source: McCorkle, Gorham and Rasberry 2005)



GCN Mammals of Maryland

Thirty-four species of mammals have been identified during the WDCP development process as species of greatest conservation need (Table 3.4). Of these, 21 are state-listed species, 11 of which are listed as threatened or endangered, 21 are of national or international concern, 11 are of conservation concern in the Northeastern U.S. region, and 6 are otherwise declining, at risk, or of uncertain status in the state. The following are designated as federally-endangered: Indiana bat, Delmarva fox squirrel, and 6 species of whales. For additional regional, national, and international ranks see Appendix 3a and 3b.

Mammals of greatest conservation need include species that require an extensive, connected landscape of habitat patches, as well as species limited to specialized habitats such as boulder and rock outcrops, caves and mines, remnant spruce-hemlock forests, and marine environments. It is noteworthy that 12 GCN species are found mostly or exclusively in the

four western counties, emphasizing again the importance of this region for the wildlife diversity of the state.

Threats to GCN mammals are related to their unique life histories. Species such as bobcat, North American porcupine, and Allegheny woodrat range over large areas through time and require connected habitat patches. Boulder and rock outcrops, threatened by human disturbance such as recent wind power development on ridgetops, provide habitat for a suite of species including long-tailed shrew, eastern small-footed myotis, and southern rock vole. The loss of spruce and hemlock habitats has particularly affected relict populations of more northern species, such as snowshoe hare. Bats face particular threats to their food source through pesticide use and reduction of aquatic prey due to pollution, and are sensitive to disturbance during hibernation and while in maternity colonies located in human structures or rock outcrops (eastern small-footed myotis). The removal of large tree snags and forest cover affects species such as Indiana bat and red bat. Urbanization has increased the level of competition and disease transmission between some GCN species and species such as raccoons that adapt well to human-altered landscapes.

Conservation Actions and Information Needs for GCN Mammals

Some of the conservation actions needed to address threats to specific GCN species are presented in recovery plans for federally-endangered species (Indiana bat, Delmarva fox squirrel, whale species). Protection of forest, wetland, and rock outcrop habitats is needed for these and other GCN species. Landscape habitat models can help to identify areas for conservation action, especially for species with large home ranges or that need connected habitat patches. The restoration of spruce and hemlock habitats, and protection through the control of hemlock woolly adelgid, would provide needed habitat for relict species and opportunities for reintroductions. Education of the public and working with industry could help to minimize bat disturbance and mortality and deter the presence of urbanized species near wildlife areas.

To determine additional conservation measures, specific information or research is needed for some GCN species. The fossorial and nocturnal habits of many GCN mammal species make inventory, monitoring, and research on basic biology and habitat needs a particular challenge for this group. For wide-ranging species, understanding the landscape configuration needed to maintain metapopulations is of primary importance. Documenting the migratory flyways of bats and how to deter collisions with wind turbines are becoming more pressing issues as wind power development increases in the eastern U.S. Best management practices need to be developed to minimize the impacts of agricultural and timber harvesting activities on forest and wetland mammals.

Table 3.4 GCN Mammals of Maryland

Common Name	Scientific Name	State-listed	Federally-listed	S - Rank	G - Rank
Allegheny woodrat	<i>Neotoma magister</i>	E		S1	G3G4
American marten	<i>Martes americana</i>	X		SX	G5
Blue whale	<i>Balaenoptera musculus</i>	E	E	SZN	G3G4

Common Name	Scientific Name	State-listed	Federally-listed	S - Rank	G - Rank
Bobcat	<i>Lynx rufus</i>	I		S3	G5
Delmarva fox squirrel	<i>Sciurus niger cinereus</i>	E	E	S1	G5T3
Eastern harvest mouse	<i>Reithrodontomys humulis</i>	X		SH	G5
Eastern red bat	<i>Lasiurus borealis</i>			S5B,S5N	G5
Eastern small-footed myotis	<i>Myotis leibii</i>	I		S1B,S2N	G3
Eastern spotted skunk	<i>Spilogale putorius</i>			S1	G5
Fin whale	<i>Balaenoptera physalus</i>	E	E	SZN	G3G4
Harbor porpoise	<i>Phocoena phocoena</i>			SZN	G4G5
Hoary bat	<i>Lasiurus cinereus</i>			SPB,S5N	G5
Humpback whale	<i>Megaptera novaeangliae</i>	E	E	SZN	G3
Indiana bat	<i>Myotis sodalis</i>	E	E	S1	G2
Least shrew	<i>Cryptotis parva</i>			S3S5	G5
Least weasel	<i>Mustela nivalis</i>	I		S2S3	G5
Long-tailed shrew	<i>Sorex dispar</i>	I		S2	G4
New England cottontail	<i>Sylvilagus transitionalis</i>	I		S1	G4
North American Porcupine	<i>Erethizon dorsatum</i>	I		S1S2	G5
Northern flying squirrel	<i>Glaucomys sabrinus</i>			SP	G5
Northern right whale	<i>Eubalaena glacialis</i>	E	E	SZN	G1
Rafinesque's big-eared bat	<i>Corynorhinus rafinesquii</i>			SP	G3G4
Sei whale	<i>Balaenoptera borealis</i>	E	E	SZN	G3
Silver-haired bat	<i>Lasionycteris noctivagans</i>			SPB,S5N	G5
Smoky shrew	<i>Sorex fumeus</i>	I		S2S3	G5
Snowshoe hare	<i>Lepus americanus</i>	X		SH	G5
Southeastern myotis	<i>Myotis austroriparius</i>			SP	G3G4
Southeastern shrew	<i>Sorex longirostris</i>			S3S4	G5
Southeastern star-nosed mole	<i>Condylura cristata parva</i>			SU	G5T4
Southern bog lemming	<i>Synaptomys cooperi</i>			S3	G5
Southern pygmy shrew	<i>Sorex hoyi winnemana</i>			S2	G5T4
Southern rock vole	<i>Microtus chrotorrhinus carolinensis</i>	E		S1	G4T3

Common Name	Scientific Name	State-listed	Federally-listed	S - Rank	G - Rank
Southern water shrew	<i>Sorex palustris punctulatus</i>	E		S1	G5T3
Sperm whale	<i>Physeter catodon</i>	E	E	SZN	G3G4

Birds of Maryland

Birds are the most familiar and widely enjoyed wildlife in North America. 423 species of birds have been accepted on the “Official List of the Birds of Maryland” (Maryland Ornithological Society 2005). This list includes two extirpated species (trumpeter swan and greater prairie chicken) and two extinct species (passenger pigeon and Carolina parakeet), as well as a large number of accidental species that have been observed only one or a few times in Maryland since records were first kept in 1804.

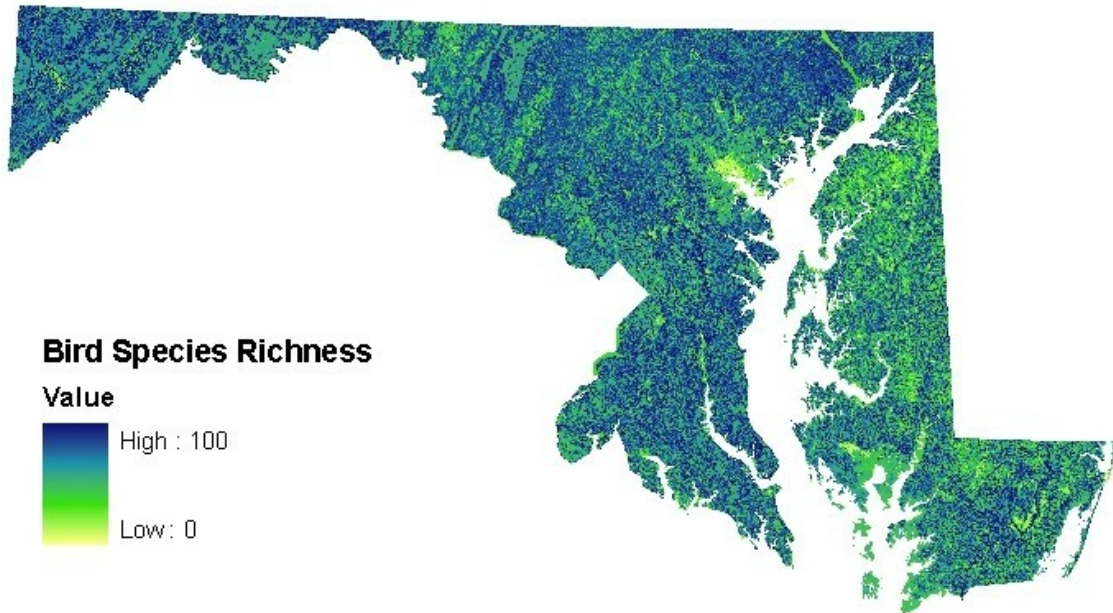
Most Maryland birds are migratory, but some, such as northern cardinal and mourning dove, are permanent residents. Many migratory species breed in the state. Other species migrate south to Maryland and spend the winter here, while other migrants simply pass through the state during spring and fall migrations. 201 species were recorded during the Breeding Bird Atlas from 1983 to 1987 (Robbins and Blom 1996).

Maryland’s importance to birds has been recognized by several organizations that have designated specific areas as particularly valuable to seabirds, wading birds, waterfowl, shorebirds and others. The Atlantic Coast Joint Venture (ACJV) has designated the Upper Western Shore, Delmarva Peninsula and Lower Western Shore as Waterfowl Focus Areas. An ACJV map is publicly available online and can be viewed at http://www.fws.gov/northeast/migratorybirds/acjv_planning.htm. The Mid-Atlantic/New England Maritime Regional Working Group for Waterbirds (MANEM) is a regional partnership working to conserve waterbirds in the Northeast, and they have identified (draft) Important Waterbird Areas for breeding seabirds, wading birds, and marshbirds for 11 states and 4 provinces in the Northeast. MANEM maps for each of the mentioned groups of waterbirds are available for each state, including Maryland, and can be viewed online at <http://www.fws.gov/birds/waterbirds/MANEM/Habitat%20Profiles.htm>. The National Audubon Society and American Bird Conservancy (Chiple et al. 2003) have designated a number of sites, including Fishing Bay Wildlife Management Area (Elliott Island), Blackwater National Wildlife Refuge (NWR), Jug Bay, Eastern Neck NWR, and Assateague Island National Seashore, as globally Important Bird Areas. Additional IBA’s are currently being identified and designated by the National Audubon Society.

Maryland’s landscape encompasses five physiographic regions, as described in Chapter 2: Lower Coastal Plain, Upper Coastal Plain, Piedmont, Ridge and Valley, and Allegheny Plateau. The diversity of habitats within these regions accounts for the diversity of birds found in the state. Because of this physiographic diversity, three Bird Conservation Regions (BCRs) occur in Maryland – New England/Mid-Atlantic Coast, Piedmont, and Appalachian Mountains (see Table 2.1). Each BCR addresses different suites of species and issues.

Additionally, numerous plans address the unique guilds or groups of bird species that occur within these regions (Appendix 1a).

Figure 3.2 Distribution of Maryland's Breeding Birds (Source: McCorkle, Gorham and Rasberry 2005)



Birds of the Coastal Plain

The avifauna of the Upper and Lower Coastal Plain is transitional and contains a mix of species mostly centered in southeastern North America, with some additional species spilling over from more inland regions. Of the Coastal Plain breeders, many species are associated with water and wetland habitats, as well as species of upland forests, shrublands, and grasslands. As would be expected, waterfowl, marsh birds, shorebirds, and colonial nesting species, aggregately known as waterbirds, are an important component of this region's avifauna (Kushlan et al. 2002). Of the perching birds, Coastal Plain specialists include brown-headed nuthatch, marsh wren, Swainson's warbler, saltmarsh sharp-tailed sparrow, seaside sparrow, and boat-tailed grackle.

The Chesapeake Bay is a major wintering area for waterfowl in the Atlantic Flyway. Most waterfowl species are game birds with established management programs administered by the USFWS with the cooperation of the DNR. Conservation actions are coordinated through the North American Waterfowl Management Plan (USFWS 1999) and the Atlantic Coast Joint Venture (ACJV 2004).

Efforts to assess Maryland's marsh bird populations began in the early 1990s (Brinker et al. 2001). Many aspects of the biology of marsh birds remain relatively poorly known as compared with other groups of birds. Even fairly basic information such as distribution during the breeding and winter seasons, timing and status of migrants, and specific habitat

preferences throughout the year are poorly documented in the literature in many geographic areas (Ribic et al. 1999).

Since the mid-1980's, DNR has had an active colonial waterbird management program to assess and monitor populations. Regional coordination through MANEM (2004) and the Colonial Waterbird and Shorebird Working Groups provide regional assessments of waterbird population status and trends.

Shorebirds are also monitored in Maryland by DNR and the National Park Service (NPS) Assateague Island National Seashore, and regionally by several Atlantic coast coordinated efforts (Clark and Niles 2000, Hunter 2003). Conservation actions in North America are provided in the U.S. Shorebird Conservation Plan (Brown et al. 2001). The piping plover, a federally threatened and state endangered shorebird, is a tiny dune-nesting species that nests on Maryland's Assateague Island and on other Atlantic coastal beaches (USFWS 1996b). The species is slowly recovering due to education of beach users, aided by signs and light fencing, the latter sometimes also being predator-resistant.

Birds of the Piedmont

Roughly 140 bird species breed within the entire mid-Atlantic Piedmont region (Carter et al. 2000). Six bird species have a disproportionately large share of their global populations breeding within this area, which extends from southern Virginia to northern New Jersey (Kearney 2003). These include five deciduous forest species (wood thrush, acadian flycatcher, scarlet tanager, Louisiana waterthrush, and eastern wood-pewee) and one species associated with early successional habitats (prairie warbler). The Piedmont is in the heart of these species' geographic ranges and, therefore, forest conservation in this region could especially benefit and sustain their populations over the long term.

Populations of three forest-nesting species exhibit significant declining trends in the Piedmont (Kearney 2003). These are the yellow-billed cuckoo, northern flicker, and great crested flycatcher. Two wetland species, black-crowned night heron and green heron, are also in decline. In contrast, a total of 40 bird species exhibit increasing trends, but those species displaying the greatest increases are habitat generalists and are either nonmigratory or short distance migrants. A number of species associated with mature forest habitats have increased locally, such as wild turkey, Cooper's hawk, red-shouldered hawk, worm-eating warbler, pileated woodpecker, northern parula.

In addition to forest-dependent species, Maryland's Piedmont habitats traditionally supported grassland species such as the horned lark, vesper sparrow, grasshopper sparrow, and eastern meadowlark, which have decreased by an average of 10% per year and are among the most steeply declining birds in the mid-Atlantic Piedmont (Kearney 2003). Dickcissel, bobolink, and upland sandpiper were once more common in the grassland habitats of this region of Maryland, and still occur occasionally. Birds of shrublands and early successional habitats, such as the field sparrow, northern bobwhite, and brown thrasher, have also seen large population declines as farming practices have changed and urbanization has increased.

Montane Birds

Habitat types of the Ridge and Valley and Allegheny Plateau include early successional forests, mesic deciduous forests, bog and fen wetland complexes, cliff and rock outcrops, and northern conifer-hardwood forests. Because this region includes some habitats that are unique within the state, it supports a number of bird species that essentially breed nowhere else in Maryland, such as northern saw-whet owl, alder flycatcher, least flycatcher, black-capped chickadee, winter wren, hermit thrush, and golden-winged, Nashville, chestnut-sided, magnolia, black-throated blue, blackburnian, and mourning warblers. Because farming practices and land-use patterns are not changing as rapidly in this region as in the remainder of the state, some species which formerly bred in other regions, such as Henslow's sparrow and upland sandpiper, now only breed in this region.

GCN Birds of Maryland

One hundred forty-one species of birds have been declared by the WDCP process as species of greatest conservation need in Maryland (Table 3.5). Of these, 29 are state-listed, 18 of which are listed as threatened or endangered, 22 are of national or international concern, and 27 are of conservation concern in the Northeastern U.S. region. An additional 86 were listed because the best available current scientific information indicates their populations are in decline or they require more specialized habitat types that are likely to be degraded.

Federally-endangered birds that formerly bred in Maryland include roseate terns and red-cockaded woodpeckers. The bald eagle is listed as federally-threatened, as is the Atlantic coast breeding population of piping plovers. Support for the recovery plans for federally listed endangered and threatened species is included in the implementation of the WDCP.

Fourteen species are considered by the Maryland DNR to be endangered in the state:

Wilson's plover, piping plover, upland sandpiper, gull-billed tern, royal tern, black skimmer, short-eared owl, olive-sided flycatcher, Bewick's wren, sedge wren, loggerhead shrike, Swainson's warbler, mourning warbler, and northern goshawk (in western Maryland). State-threatened species include the bald eagle, least tern, blackburnian warbler, and Henslow's sparrow. For additional regional, national, and international ranks see Appendix 3a and 3b.

GCN bird species are negatively affected by certain factors more so than other taxa groups. For example, 49 GCN bird species are very sensitive to habitat fragmentation. Forest species, such as worm-eating warbler and red-shouldered hawk, and grassland species, such as Henslow's sparrow and short-eared owl, will not nest or are likely to have greatly reduced nest success in areas below a certain size. Fragmentation also opens up habitats to increased nest parasitism by brown-headed cowbirds. Conversion of native forest communities to commercial pine plantations alters the suitability of the habitat for most GCN forest species, and overbrowsing by deer removes critical habitat structure for some forest nesters. Grassland birds such as dickcissel and bobolink are further threatened by changes in agricultural practices such as earlier mowing. Beach-nesting shorebirds and colonial waterbirds face special challenges as they are concentrated in areas with increased recreational use, expanding gull populations, and shoreline development. Disturbance of colonial waterbird colonies is of special concern given the potential to negatively affect the breeding success of a large group of birds by impacting just one or a few areas.

The vast saltmarsh habitats of Maryland support the regional stronghold of rails and saltmarsh sparrows, such as black rail and coastal plain swamp sparrow. Contamination and drainage of these and other marsh habitats through development and mosquito control efforts can be a serious problem for marsh-nesting species. As in mammal GCN species, some bird species, such as northern saw-whet owl and golden-crowned kinglet, are dependent on relict northern spruce-hemlock habitats that have been greatly reduced in size.

Twenty-one species of greatest conservation need do not breed in Maryland, but overwinter or stop in Maryland during migration. Migratory stopover or wintering habitat is critical for these species, most of which are shorebirds or waterfowl. Disturbance of beach habitats and the absence of horseshoe crab eggs for shorebirds (especially red knot), entanglement in fishing nets for seabirds, and degradation of aquatic habitats for waterfowl threaten these groups of GCN species. Several general threats to birds also affect GCN species to differing degrees. Collisions with towers, windows, cars, and other human structures kill many thousands of birds each year. GCN species face competition for nest sites with introduced bird species, and free-ranging domestic cats kill millions of birds annually in the U.S.

Conservation Actions and Information Needs for GCN Birds

To address the special needs of GCN bird species, more information is particularly needed on migratory stopover and overwintering requirements; area sensitivity (forest, grassland, and marsh species); and inventory of nocturnal species. Information needs and conservation actions for breeding federally-listed species (piping plover, bald eagle) can be found in their respective recovery plans. Partners in Flight has produced conservation plans that include Maryland GCN species, and plans are under development that will include species of concern in the Mid-Atlantic and Appalachian Bird Conservation Regions designated by the North American Bird Conservation Initiative. Recommendations for GCN waterbirds, seabirds, and waterfowl are included in other regional plans. Landscape-level habitat information can be used to identify priority areas for conservation and restoration of habitat for area sensitive and northern habitat species, which should include control of hemlock wooly adelgid. The recent designation of Important Bird Areas (IBA) by Audubon Maryland/DC will assist with this effort. There is considerable overlap between the components of the IBA program and this plan, thus collaboration between the two will enhance bird conservation efforts in Maryland. Fragmentation and habitat destruction for forest-interior species can be limited by conserving the remaining large blocks of unfragmented forests, controlling urban sprawl through implementation of the state's smart growth initiatives, and limiting forest conversion to monotypic pine plantations. Work with the public can encourage the protection of GCN species at migratory stopover sites, beach-nesting sites, waterbird nesting colonies, and through control of predation by free-ranging cats. Control of introduced and invasive bird species, predators, and deer populations continues to be needed to conserve some nesting bird species. Food resources of GCN birds can be protected by limiting the use of pesticides and overharvest of horseshoe crabs. Encouraging farming practices that favor grassland and shrub-scrub nesting species, such as late mowing, hedgerow establishment, and reduced pesticide use can benefit a number of GCN species. Retention and improvement of aquatic habitats for GCN birds can be achieved by controlling common reed, restoring marshes, the enforcement of wetland protection laws, and the reduction of by-catch by commercial

fisheries. Working with a variety of partners will be critical to minimize mortality due to collisions.

Table 3.5 GCN Birds of Maryland

Common Name	Scientific Name	State-listed	Federally-listed	S – Rank	G - Rank
Acadian flycatcher	<i>Empidonax virescens</i>			S5B	G5
Alder flycatcher	<i>Empidonax alnorum</i>	I		S2B	G5
American bittern	<i>Botaurus lentiginosus</i>	I		S1S2B,S1N	G4
American black duck	<i>Anas rubripes</i>			S4B,S5N	G5
American oystercatcher	<i>Haematopus palliatus</i>			S3B,SAN	G5
American peregrine falcon	<i>Falco peregrinus anatum</i>	I		S2	G4T3
American redstart	<i>Setophaga ruticilla</i>			S4B	G5
American woodcock	<i>Scolopax minor</i>			S4B,S4N	G5
Bachman's sparrow	<i>Aimophila aestivalis</i>	X		SHB	G3
Bald eagle	<i>Haliaeetus leucocephalus</i>	T	T	S2S3B,S3N	G4
Bank swallow	<i>Riparia riparia</i>			S3S4B	G5
Barn owl	<i>Tyto alba</i>			S3	G5
Barred owl	<i>Strix varia</i>			S5	G5
Bewick's wren	<i>Thryomanes bewickii altus</i>	E		S1B	G5T2Q
Bicknell's thrush	<i>Catharus bicknellii</i>			SZN	G4
Black rail	<i>Laterallus jamaicensis</i>	I		S2S3B	G4
Black skimmer	<i>Rynchops niger</i>	E		S1B	G5
Black tern	<i>Chlidonias niger</i>			SZN	G4
Black-and-white warbler	<i>Mniotilta varia</i>			S4B	G5
Black-bellied plover	<i>Pluvialis squatarola</i>			S3N	G5
Black-billed cuckoo	<i>Coccyzus erythrophthalmus</i>			S4B	G5
Blackburnian warbler	<i>Dendroica fusca</i>	T		S1S2B	G5
Black-crowned night-heron	<i>Nycticorax nycticorax</i>			S3B,S2N	G5
Black-throated blue warbler	<i>Dendroica caerulescens</i>			S3S4B	G5

Common Name	Scientific Name	State-listed	Federally-listed	S – Rank	G - Rank
Black-throated green warbler	<i>Dendroica virens</i>			S4B	G5
Blue-headed vireo	<i>Vireo solitarius</i>			S3S4B	G5
Blue-winged warbler	<i>Vermivora pinus</i>			S4B	G5
Boat-tailed grackle	<i>Quiscalus major</i>			S3S4	G5
Bobolink	<i>Dolichonyx oryzivorus</i>			S3S4B	G5
Brant	<i>Branta bernicla</i>			S3N	G5
Broad-winged hawk	<i>Buteo platypterus</i>			S4B	G5
Brown creeper	<i>Certhia americana</i>			S4	G5
Brown pelican	<i>Pelecanus occidentalis</i>			S1B	G4
Brown thrasher	<i>Toxostoma rufum</i>			S5B,S2N	G5
Brown-headed nuthatch	<i>Sitta pusilla</i>			S3S4	G5
Canada warbler	<i>Wilsonia canadensis</i>			S3B	G5
Canvasback	<i>Aythya valisineria</i>			S3S4N	G5
Cerulean warbler	<i>Dendroica cerulea</i>			S3S4B	G4
Chestnut-sided warbler	<i>Dendroica pensylvanica</i>			S4B	G5
Chuck-will's-widow	<i>Caprimulgus carolinensis</i>			S4B	G5
Coastal plain swamp sparrow	<i>Melospiza georgiana nigrescens</i>	I		S2B,SZN	G5T3
Common loon	<i>Gavia immer</i>			S4N	G5
Common moorhen	<i>Gallinula chloropus</i>	I		S2B,SAN	G5
Common nighthawk	<i>Chordeiles minor</i>			S3S4B	G5
Common raven	<i>Corvus corax</i>			S2	G5
Common tern	<i>Sterna hirundo</i>			S4B	G5
Dark-eyed junco	<i>Junco hyemalis</i>			S2B,S5N	G5
Dickcissel	<i>Spiza americana</i>			S2B	G5
Dunlin	<i>Calidris alpina</i>			S3N	G5
Eastern meadowlark	<i>Sturnella magna</i>			S5B,S3N	G5
Eastern towhee	<i>Pipilo erythrophthalmus</i>			S5B,S4N	G5
Field sparrow	<i>Spizella pusilla</i>			S5	G5
Forster's tern	<i>Sterna forsteri</i>			S4B	G5
Glossy ibis	<i>Plegadis falcinellus</i>			S4B	G5
Golden eagle	<i>Aquila chrysaetos</i>			S1N	G5

Common Name	Scientific Name	State-listed	Federally-listed	S – Rank	G - Rank
Golden-crowned kinglet	<i>Regulus satrapa</i>			S2B,S4N	G5
Golden-winged warbler	<i>Vermivora chrysoptera</i>			S3B	G4
Grasshopper sparrow	<i>Ammodramus savannarum</i>			S4B	G5
Great blue heron	<i>Ardea herodias</i>			S4B,S3S4N	G5
Great egret	<i>Ardea alba</i>			S4B	G5
Greater yellowlegs	<i>Tringa melanoleuca</i>			S1N	G5
Gull-billed tern	<i>Sterna nilotica</i>	E		S1B	G5
Hairy woodpecker	<i>Picoides villosus</i>			S5	G5
Harlequin duck	<i>Histrionicus histrionicus</i>			S1N	G4
Henslow's sparrow	<i>Ammodramus henslowii</i>	T		S1S2B	G4
Hermit thrush	<i>Catharus guttatus</i>			S3S4B,S4N	G5
Hooded warbler	<i>Wilsonia citrina</i>			S4S5B	G5
Horned grebe	<i>Podiceps auritus</i>			S4N	G5
Kentucky warbler	<i>Oporornis formosus</i>			S4B	G5
King rail	<i>Rallus elegans</i>			S3S4B,S2N	G4G5
Laughing gull	<i>Larus atricilla</i>			S1B,S4N	G5
Least bittern	<i>Ixobrychus exilis</i>	I		S2S3B	G5
Least flycatcher	<i>Empidonax minimus</i>			S3S4B	G5
Least tern	<i>Sterna antillarum</i>	T		S2B	G4
Little blue heron	<i>Egretta caerulea</i>			S3B	G5
Loggerhead shrike	<i>Lanius ludovicianus</i>	E		S1B,S1N	G4
Long-eared owl	<i>Asio otus</i>			SHB,S1N	G5
Louisiana waterthrush	<i>Seiurus motacilla</i>			S5B	G5
Magnolia warbler	<i>Dendroica magnolia</i>			S3S4B	G5
Marsh wren	<i>Cistothorus palustris</i>			S4B,S2N	G5
Mourning warbler	<i>Oporornis philadelphia</i>	E		S1B	G5
Nashville warbler	<i>Vermivora ruficapilla</i>	I		S1S2B	G5
Northern bobwhite	<i>Colinus virginianus</i>			S5	G5
Northern gannet	<i>Morus bassanus</i>			SZN	G5
Northern goshawk	<i>Accipiter gentilis</i>	E*		S1B,SZN	G5
Northern harrier	<i>Circus cyaneus</i>			S2B,S4N	G5
Northern parula	<i>Parula americana</i>			S4S5B	G5
Northern saw-whet owl	<i>Aegolius acadicus</i>			S1B,S1N	G5

Common Name	Scientific Name	State-listed	Federally-listed	S – Rank	G - Rank
Northern waterthrush	<i>Seiurus noveboracensis</i>			S2S3B	G5
Olive-sided flycatcher	<i>Contopus cooperi</i>	E		SHB,SZN	G4
Ovenbird	<i>Seiurus aurocapillus</i>			S5B	G5
Pied-billed grebe	<i>Podilymbus podiceps</i>			S2B,S3N	G5
Pileated woodpecker	<i>Dryocopus pileatus</i>			S5	G5
Piping plover	<i>Charadrius melodus</i>	E	T	S1B,SAN	G3
Prairie warbler	<i>Dendroica discolor</i>			S4B	G5
Prothonotary warbler	<i>Protonotaria citrea</i>			S4B	G5
Purple sandpiper	<i>Calidris maritima</i>			S2N	G5
Red knot	<i>Calidris canutus</i>			SZN	G5
Red-breasted nuthatch	<i>Sitta canadensis</i>			S1B,S3N	G5
Red-cockaded woodpecker	<i>Picoides borealis</i>	X	E	SHB,SAN	G3
Red-eyed vireo	<i>Vireo olivaceus</i>			S5B	G5
Red-headed woodpecker	<i>Melanerpes erythrocephalus</i>			S4	G5
Red-shouldered hawk	<i>Buteo lineatus</i>			S4S5B,S4N	G5
Red-throated loon	<i>Gavia stellata</i>			S3S4N	G5
Roseate tern	<i>Sterna dougallii</i>	X	E	SHB,SAN	G4
Royal tern	<i>Sterna maxima</i>	E		S1B	G5
Ruddy duck	<i>Oxyura jamaicensis</i>			S3N	G5
Ruddy turnstone	<i>Arenaria interpres</i>			S1N	G5
Saltmarsh sharp-tailed sparrow	<i>Ammodramus caudacutus</i>			S3B,S1N	G4
Sanderling	<i>Calidris alba</i>			S3N	G5
Sandwich tern	<i>Sterna sandvicensis</i>			S1B	G5
Savannah sparrow	<i>Passerculus sandwichensis</i>			S3S4B,S4N	G5
Scarlet tanager	<i>Piranga olivacea</i>			S5B	G5
Seaside sparrow	<i>Ammodramus maritimus</i>			S4B,S2N	G4
Sedge wren	<i>Cistothorus platensis</i>	E		S1B	G5
Semipalmated sandpiper	<i>Calidris pusilla</i>			SZN	G5
Sharp-shinned hawk	<i>Accipiter striatus</i>			S1S2B,S4N	G5

Common Name	Scientific Name	State-listed	Federally-listed	S – Rank	G - Rank
Short-billed Dowitcher	<i>Limnodromus griseus</i>			SZN	G5
Short-eared owl	<i>Asio flammeus</i>	E		S1B,S2N	G5
Snowy egret	<i>Egretta thula</i>			S3S4B	G5
Solitary sandpiper	<i>Tringa solitaria</i>			SZN	G5
Summer tanager	<i>Piranga rubra</i>			S4B	G5
Swainson's thrush	<i>Catharus ustulatus</i>			SXB	G5
Swainson's warbler	<i>Limnithlypis swainsonii</i>	E		S1B	G4
Tricolored heron	<i>Egretta tricolor</i>			S3B	G5
Upland sandpiper	<i>Bartramia longicauda</i>	E		S1B	G5
Veery	<i>Catharus fuscescens</i>			S4B	G5
Vesper sparrow	<i>Poocetes gramineus</i>			S3S4B,S2N	G5
Wayne's black-throated green warbler	<i>Dendroica virens waynei</i>			SU	G5TU
Whimbrel	<i>Numenius phaeopus</i>			SZN	G5
Whip-poor-will	<i>Caprimulgus vociferus</i>			S3S4B	G5
Willet	<i>Catoptrophorus semipalmatus</i>			S3S4B	G5
Willow flycatcher	<i>Empidonax traillii</i>			S4B	G5
Wilson's plover	<i>Charadrius wilsonia</i>	E		S1B	G5
Wilson's snipe	<i>Gallinago delicata</i>			S2N	G5
Winter wren	<i>Troglodytes troglodytes</i>			S2B,S3N	G5
Wood thrush	<i>Hylocichla mustelina</i>			S5B	G5
Worm-eating warbler	<i>Helmitheros vermivorus</i>			S4B	G5
Yellow-bellied sapsucker	<i>Sphyrapicus varius</i>			SHB,S3N	G5
Yellow-crowned night-heron	<i>Nyctanassa violacea</i>			S2B	G5
Yellow-throated vireo	<i>Vireo flavifrons</i>			S4S5B	G5

Reptiles and Amphibians of Maryland

The NHP database includes 41 amphibians and 49 reptiles as being native to or likely to be found in the state. The most recent published account of the Maryland herpetofauna (Harris 1975) is now out of date. The Maryland Herpetological Society (MDHS) publishes local and statewide information in its bulletin and updates of information can be found in their

newsletter and their website (www.naturalhistory.org). This is the best available scientific information regarding all herpetofauna in Maryland. Detailed scientific information on a number of individual species is available in the literature and from other sources.

Although members of the two groups often are found together, moist-skinned amphibians are most abundant either in the cool damp forests such as of the western counties or in or near aquatic or wetland habitats throughout the state. By contrast, most reptiles (snakes, lizards, and some kinds of turtles) are more suited to warm and dry environments, where their dry and relatively impermeable skin conserves water. Amphibians generally are intolerant of even low concentrations of salt water, but the marine environment is not a barrier to many kinds of reptiles, in Maryland notably the seaturtles.

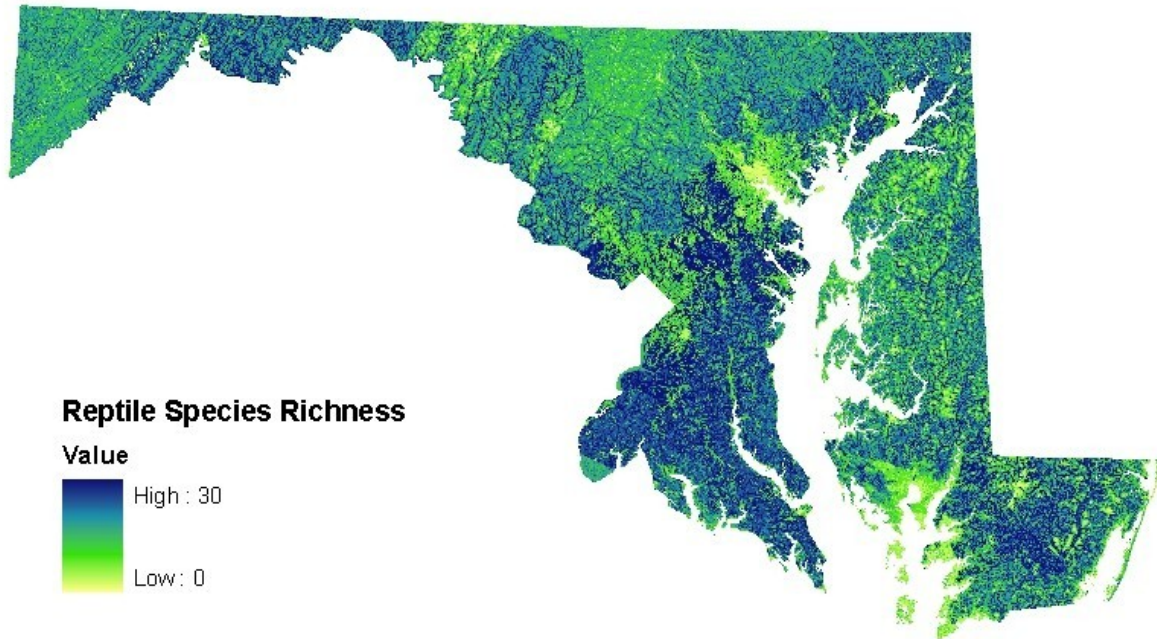
Reptiles

Native reptiles in Maryland include 18 turtles, 7 lizards, and 24 snakes. Maryland's 18 turtles range from the highly aquatic eastern spiny softshell to the terrestrial eastern box turtle to the 5 seaturtles that visit Maryland's ocean waters, the Chesapeake Bay and its estuaries during the warmer months. The marine turtles are large to massive, have their forefeet modified as flippers, and have specialized salt glands to maintain proper water balance while living in the marine environment. Seaturtle strandings are documented for Maryland's coastline and in the Chesapeake Bay. The DNR's Fisheries Service manages two turtle species commonly found in the Chesapeake Bay watershed – the northern diamond-backed terrapin and the snapping turtle – as commercial species with regulations controlling harvest methods and seasons. The northern diamond-backed terrapin is the only truly estuarine reptile in Maryland. Although most other turtles can tolerate some salt water, the eastern snapping turtle lives in brackish water more than the other turtles on Assateague Island (Mitchell and Anderson 1994). The spotted turtle and especially the bog turtle inhabit freshwater wetlands; most of the other species are stream and pond inhabitants.

Maryland's seven lizards are small, four-legged, slender, and long-tailed. The common five-lined skink and the fence lizard are widespread and by inference tolerate a wide range of habitats. Others, such as the northern coal skink is found in montane western Maryland, whereas the broad-headed skink probably is restricted to the eastern half of the state. Only the fence lizard was found on Assateague Island (Mitchell and Anderson 1994).

The 24 snakes in Maryland range from the tiny, earthworm-like eastern wormsneak to the thick-bodied, heavy, and venomous timber rattlesnake. About half of Maryland snakes lay eggs and the rest are live-bearers, females retaining eggs during development. Maryland's snakes are carnivorous, eating a range of foods from invertebrates to small mammals. Most are terrestrial or even arboreal, and a few, such as the watersnakes are semiaquatic.

Figure 3.4 Distribution of Maryland's Reptiles (Source: McCorkle, Gorham and Rasberry 2005)



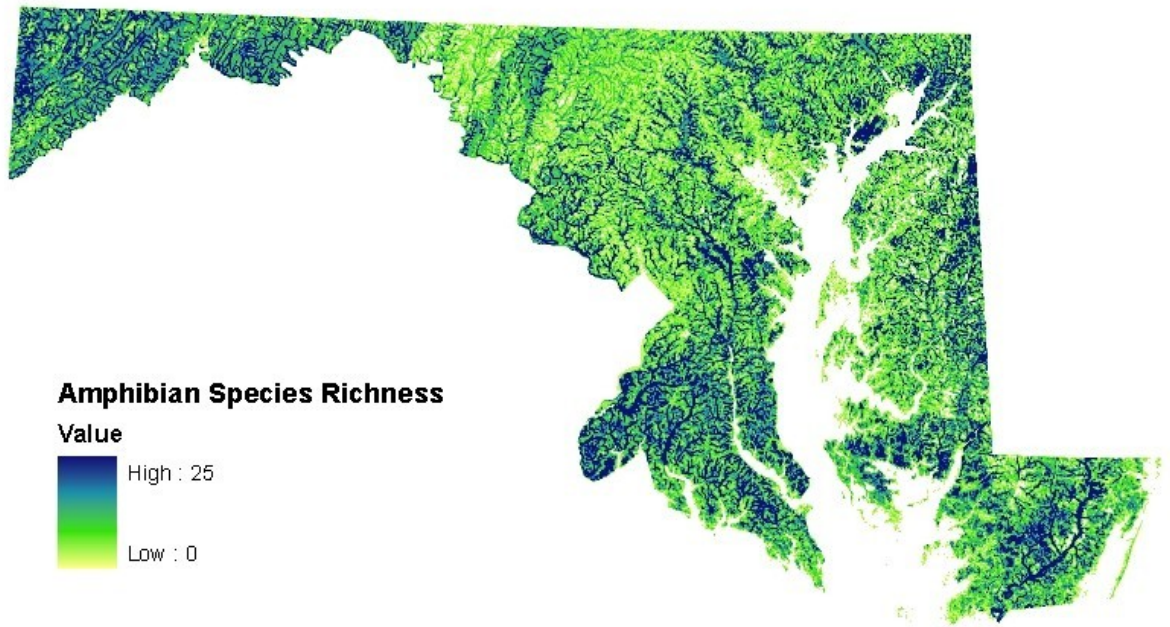
Amphibians

Maryland's list of amphibians includes 21 salamanders and 20 frogs and toads. Globally, widespread and largely unexplained declines in amphibians have been observed since 1980, and the need to identify the specific causes of these declines is urgent (Gibbons et al. 2000). Declines in some species may be due to over-exploitation, whereas habitat loss also contributes to declines in some species (Stuart et al. 2004). But the sharpest declines are "enigmatic" (no known or obvious cause), especially for stream-dwelling species in tropical locations, often in seemingly pristine conditions. For reasons that are unclear, the declines have been slow and fewest in North America, where the best information on populations exists. There is a recognized national and regional need for advocacy focused on conservation and the use of an ecosystem approach to incorporate protection of amphibian and reptilian species into existing management plans (PARC 1999, SE PARC 2004, NE PARC in press).

Many amphibians require vernal or other fish-free ponds, slow-moving streams, or non-tidal wetlands for breeding. The 21 species of salamanders found in Maryland are sensitive to human sprawl and the associated habitat fragmentation. According to a survey conducted by the EPA, even the slightest bit of urbanization, less than 3%, has contributed to the disappearance of three salamanders, namely mountain dusky, seal, and northern slimy salamanders (Boward et al. 1999). Many salamanders seek traditional breeding sites, shortly after emergence from hibernation in late winter or early spring. When habitats are fragmented, it often becomes difficult or impossible for these salamanders to reach breeding sites. If their breeding sites are altered or destroyed, then breeding truly becomes impossible,

unless alternative sites can be found. Because water temperature is critical to successful reproduction in many species, delays in finding breeding sites can result in failed reproduction. Four of Maryland's amphibian species belong to the Ambystomatidae, the mole salamanders, a family in which the rate of population decline is greater than the average for all amphibians (Stuart et al. 2004).

Figure 3.3 Distribution of Maryland's Amphibians (Source: McCorkle, Gorham and Rasberry 2005)



Most of Maryland's frogs and toads belong to three families (Bufonidae, toads; Hylidae, treefrogs and their allies; and Ranidae, true frogs) that are experiencing the sharpest declines worldwide (Stuart et al. 2004). Although most species lay eggs in water, toads and some frogs are terrestrial as adults, the latter living in cool damp habitats where their moist skin does not readily desiccate. Each species of frog and toad has a distinctive mating call, usually made at night when most breeding activity occurs. After breeding, most frogs and toads go silent and then their presence is much harder to detect.

GCN Reptiles and Amphibians of Maryland

Forty-two species of amphibians and reptiles have been identified by the WDCP process as species of greatest conservation need in Maryland (Table 3.6). Of these, 17 are amphibians and 25 are reptiles. Of these, 9 amphibians and 11 reptiles are state-listed, including 6 amphibians and 10 reptiles listed as threatened or endangered; 1 amphibian and 10 reptiles are of national or international concern; and 9 amphibians and 13 reptiles are of conservation concern in the Northeastern U.S. region. An additional 4 amphibians and 3 reptiles are included due to concerns of declining populations or for other reasons. For additional regional, national, and international ranks see Appendix 3a and 3b.

Six reptiles are listed as federally-endangered or threatened species. The loggerhead and green sea turtles are listed as threatened, and Kemp's Ridley, hawksbill, and leatherback sea turtles are listed as endangered. To improve the population status regionally, the USFWS, NMFS, and other partners coordinate the actions identified by the Federal Recovery Plans for these species (NMFS and USFWS 1991a, 1991b, 1992a, 1992b; 1993). There is also a state-specific plan to conserve these sea turtles along with other marine animals in Maryland (Litwiler 2001). The bog turtle is also federally listed and its recovery plan (USFWS 2001) is being implemented in Maryland. These plans contain detailed status and distribution information as well as prioritized conservation actions, based on surveys and other research results.

Almost all of the GCN amphibians include species that rely on freshwater streams, vernal pools, or ponds for all or some of their life stages. Threats such as pollution, acid mine drainage, and sedimentation due to erosion and run-off from impervious surfaces can seriously impact populations of these species by making water conditions unsuitable. Watershed deforestation impacts include changes in water temperature, sedimentation, and a decrease in organic inputs that maintain a food base. These threats are especially of concern in western Maryland, where 8 of the 10 extant GCN salamander species are found. In addition, Wehrle's and green salamanders rely on moist rock crevices and are especially vulnerable to the destruction of rock outcrops and the removal of forest canopy that alters substrate moisture. Forest reptiles, including mountain earth snake, broad-headed skink, and eastern box turtle are also threatened by deforestation and fragmentation due to timber harvests, habitat conversion and road building. In some areas of the state, hydrological changes and groundwater withdrawal threaten the continued presence of critical water bodies for aquatic species. The loss of beaver impoundments, overgrazing, and ditching and draining of marshes and wetlands have further impacted populations of some amphibians and reptiles through the loss of habitat, including the federally-listed bog turtle. Aquatic snakes, such as queen, rainbow, and red-bellied water snake, turtles that rely on riverine and pool habitats such as wood, eastern spiny softshell, and map face threats similar to GCN amphibians. In the marine environment, sea turtles are subject to boat collisions and ingestion of trash. Northern diamond-backed terrapin is also threatened as a non-target capture in commercial and recreational crab traps. In addition, shoreline development and structural stabilization threatens nesting areas for the terrapin.

The use of different habitats at different times of year for breeding, overwintering, and developing into adult stages further increases the vulnerability of GCN amphibians and reptiles to landscape-level fragmentation and the loss of travel corridors. Movements between these habitats also result in road mortalities for frogs, toads, turtles, snakes, and skinks. Unlike most other GCN species, some reptiles and amphibians are increasingly threatened by illegal collection. Snakes in general and venomous snakes in particular are harassed and often killed when perceived to be a threat. The hibernacula of timber rattlesnakes are particularly vulnerable to harassment, destruction, and illegal collecting activities.

Conservation Actions and Information Needs for GCN Reptiles and Amphibians

In order to better conserve GCN reptiles and amphibians, seasonal movements and needs of different life stages should be investigated for a number of species. Understanding the impacts of roads, development, and forest harvest practices on GCN species would also assist in their conservation. Direct inputs of contaminants to aquatic environments can be reduced through improved stormwater management practices, minimizing and mitigating acid mine drainage, controlling illegal dumping and wastewater inputs, minimizing the use of pesticides, and establishing adequate buffers of upland habitat. State and local wetland laws should be appended as needed to protect critical habitats for GCN amphibians, turtles, and snakes. Compatible management of the landscape in order to conserve aquatic habitats needs to include reduction of impervious surfaces, groundwater withdrawal, stream bank erosion, and watershed deforestation through better design and placement of developments, and improved timber harvest and agricultural practices. Restoration of key wetland habitats, such as beaver impoundments, and plugging ditches can help to address wetland losses. Road mortality may be minimized or mitigated through road design and placement. For marine and estuarine turtles, collision injuries and impacts related to commercial harvest activities may be reduced by working with the fishing industry, recreational boaters, and crab harvesters. Enforcement of existing state regulations on possession and trade of amphibians and reptiles, and revision of those regulations for further protection, are critical. In addition, education and outreach are needed to reduce illegal collecting and killing of reptiles and amphibians. Other inventory and research needs, and actions for conservation are included in seaturtle recovery plans, the bog turtle recovery plan, and the regional plan for northern diamond-backed terrapin.

Table 3.6 GCN Amphibians and Reptiles of Maryland

Common Name	Scientific Name	State-listed	Federally-listed	S – Rank	G - Rank
Amphibians					
Allegheny Mountain dusky salamander	<i>Desmognathus ochrophaeus</i>			S5	G5
Barking treefrog	<i>Hyla gratiosa</i>	E		S1	G5
Carpenter frog	<i>Rana virgatipes</i>	I		S2	G5
Eastern narrow-mouthed toad	<i>Gastrophryne carolinensis</i>	E		S1S2	G5
Eastern spadefoot	<i>Scaphiopus holbrookii</i>			S4	G5
Eastern tiger salamander	<i>Ambystoma tigrinum</i>	E		S2	G5
Green salamander	<i>Aneides aeneus</i>	E		S2	G3G4
Hellbender	<i>Cryptobranchus alleganiensis</i>	E		S1	G3G4
Jefferson salamander	<i>Ambystoma jeffersonianum</i>			S3	G4
Long-tailed salamander	<i>Eurycea</i>			S5	G5

Common Name	Scientific Name	State-listed	Federally-listed	S – Rank	G - Rank
	<i>longicauda</i>				
Mountain chorus frog	<i>Pseudacris brachyphona</i>	T		S2	G5
Mud salamander	<i>Pseudotriton montanus</i>			S2?	G5
Mudpuppy	<i>Necturus maculosus</i>	X		S1	G5
New jersey chorus frog	<i>Pseudacris triseriata kalmi</i>			S4	G5T4
Red salamander	<i>Pseudotriton ruber</i>			S5	G5
Seal salamander	<i>Desmognathus monticola</i>			S5	G5
Wehrle's salamander	<i>Plethodon wehrlei</i>	I		S2	G5
Reptiles					
Atlantic hawksbill seaturtle	<i>Eretmochelys imbricata</i>	E	E	SRN	G3
Bog turtle	<i>Clemmys muhlenbergii</i>	T	T	S2	G3
Broad-headed skink	<i>Eumeces laticeps</i>			S4	G5
Cornsnake	<i>Elaphe guttata</i>			S4	G5
Eastern box turtle	<i>Terrapene carolina</i>			S5	G5
Eastern hog-nosed snake	<i>Heterodon platirhinos</i>			S5	G5
Eastern ribbonsnake	<i>Thamnophis sauritus</i>			S5	G5
Eastern spiny softshell	<i>Apalone spinifera</i>	I		S1	G5
Green seaturtle	<i>Chelonia mydas</i>	T	T	S1N	G3
Kemp's ridley seaturtle	<i>Lepidochelys kempii</i>	E	E	S1N	G1
Leatherback seaturtle	<i>Dermochelys coriacea</i>	E	E	S1	G2
Loggerhead seaturtle	<i>Caretta caretta</i>	T	T	S1B,S1N	G3
Mountain earthsnake	<i>Virginia valeriae pulchra</i>	E		S2	G5T3T4
Northern coal skink	<i>Eumeces anthracinus</i>	E		SU	G5
Northern diamond-backed	<i>Malaclemys</i>			S4	G4T4

Common Name	Scientific Name	State-listed	Federally-listed	S – Rank	G - Rank
terrapin	<i>terrapin</i> <i>terrapin</i>				
Northern map turtle	<i>Graptemys</i> <i>geographica</i>	E*		S1	G5
Northern pinesnake	<i>Pituophis</i> <i>melanoleucus</i>			SH	G4
Northern red-bellied cooter	<i>Pseudemys</i> <i>rubriventris</i>			S5	G5
Northern scarletsnake	<i>Cemophora</i> <i>coccinea</i>			S3	G5
Queen snake	<i>Regina</i> <i>septemvittata</i>			S5	G5
Rainbow snake	<i>Farancia</i> <i>erythrogramma</i>	E		S1	G5
Red-bellied watersnake	<i>Nerodia</i> <i>erythrogaster</i> <i>erythrogaster</i>			S2S3	G5T5
Spotted turtle	<i>Clemmys</i> <i>guttata</i>			S5	G5
Timber rattlesnake	<i>Crotalus</i> <i>horridus</i>			S3	G4
Wood turtle	<i>Glyptemys</i> <i>insculpta</i>			S4	G4

Fishes of Maryland

The Chesapeake Bay, Coastal Bays, Atlantic Ocean, and Maryland's rivers, streams, lakes, and ponds are home to many types of freshwater and saltwater fish. Some of the state's fish species are freshwater residents, such as brook trout and mud sunfish. Some fish are residents of the estuaries, including hogchoker and northern pipefish. Scup and bluefin tuna are among the fish species that live in marine waters, and several species of shark are highly migratory, traveling long distances. Anadromous fish species that utilize Maryland's freshwater rivers for spawning include striped bass, shad, and herring. Some species (e.g. red drum, tautog, Atlantic croaker) spawn in marine waters but rely upon estuaries for juvenile development, while still other marine species spawn in estuaries (e.g. weakfish) or use them as foraging habitat (e.g. black drum).

Maryland has a number of game fish. For example, trout are found in the streams of the mountains to the Piedmont, striped bass occur in the Chesapeake Bay, and marlin and tuna inhabit the open waters of the Atlantic. Numerous species have been stocked in Maryland's streams over the past 125 years, including largemouth bass, trout and carp (Boward et al. 1999). DNR Fisheries Service currently stocks a number of ponds, lakes and streams with warm-water and cold-water species every year; in the spring of 2005, a total of 426,650 trout

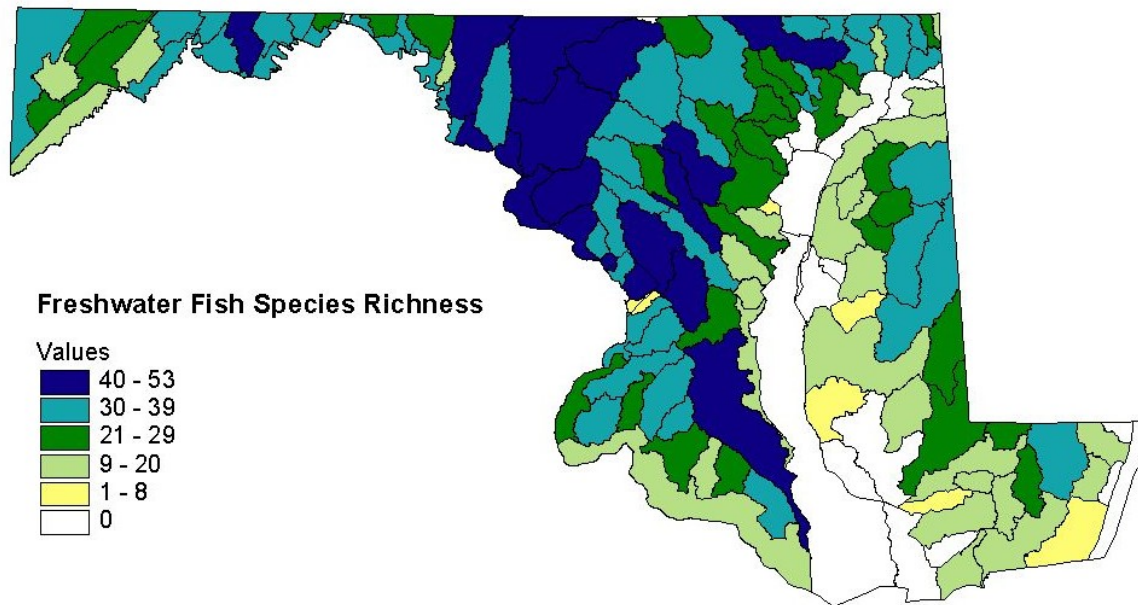
were released. The Fishery Management Plan (FMP) Workgroup of the Chesapeake Bay Program (CBP) has developed fish management plans guiding conservation of the major fish species in the Chesapeake Bay, including Atlantic croaker and spot (CBP 1991a), king mackerel and Spanish mackerel (CBP 1994a), red drum (CBP 1993a), black drum (CBP 1993b), shad and herring (CBP 1989a), striped bass (CBP 1989b), summer flounder (CBP 1991b) and tautog (CBP 1998a). The CBP is also working on four ecosystem based FMPs. The ecosystem plans will consider multi-species interactions and habitat considerations. The Atlantic States Marine Fisheries Council (ASMFC), Mid-Atlantic Fishery Management Council (MAFMC) and NMFS have also developed FMPs for numerous fish species that are found in the state's Atlantic waters. Both organizations are promoting habitat management and protection in their plans (Appendix 1a)

Freshwater Fishes

DNR's Maryland Biological Stream Survey (MBSS) collected 85 fish species representing 72% of the total number of freshwater fish species occurring in the state of Maryland from 1995-1997 (Boward et al. 1999, Roth et al. 1999). The survey sampled 17 different basins, and only three species of freshwater fish were found to occur in all basins, namely the bluegill, largemouth bass, and pumpkinseed. The most common fish in Maryland's streams include the blacknose dace, eastern mudminnow, creek chub, blue ridge sculpin, mottled sculpin, and tessellated darter. The Maryland Biological Stream Survey maintains the best available scientific information regarding population status, abundance, and distribution of freshwater fishes in the state.

In order to maintain recreational fisheries, many non-native fish were introduced to Maryland dating as far back as 1870 (Boward et al. 1999). At least 20-25 introduced fish inhabit Maryland's waters, and some have acclimated very well, like the popular largemouth bass and the not-so-popular common carp. DNR has recently expended much effort to eradicate several populations of the northern snakehead, an illegally introduced predatory fish from Asia, before it becomes established.

Figure 3.5 Distribution of Maryland's Freshwater Fishes by watershed (Source: DNR MBSS)



Marine and Estuarine Fishes

Maryland's marine and estuarine waters host a diverse array of fish, with the Chesapeake Bay hosting 350 fish species, the Coastal Bays more than 140 fish species of finfish, and the Atlantic Ocean being home to hundreds more (MD DNR 2004c, Pyzik et al. 2004). The 2001 commercial landings of finfish and shellfish from Chesapeake Bay were worth \$175 million (Pyzik et al. 2004). More than one million anglers are estimated to travel to Chesapeake Bay each year for sportfishing. The Maryland Sportfishing Tournament, sponsored by DNR, was recently established to recognize anglers and promote recreational fishing opportunities in the state. A number of Maryland's marine and estuarine fish species have been overfished or show serious population declines, leading to the adoption of fishery management plans to conserve many individual species.

The marine species are all commercially valuable species and although many have existing Fishery Management Plans to guide their conservation (e.g., striped bass, spiny dogfish, monkfish, scup), harvest pressure coupled with impaired habitat has resulted in population declines and many questions on the status of forage species, trophic interactions and the loss of critical spawning and nursery habitat remain unanswered. Sharks, marlin and tuna are highly migratory species that move over large areas of the ocean and are not permanent residents of the state's marine waters. As a result, their management requires regional, national and sometimes international partnerships. The National Marine Fisheries Service monitors the status of highly migratory species and has developed a fishery management plan (NMFS 2003) outlining conservation efforts for sharks, tuna and swordfish.

GCN Fishes of Maryland

Forty species of fish have been identified by the WDCP process as in greatest conservation need in Maryland (Table 3.7). Of these, 21 species are state-listed, 13 of which are listed as

threatened or endangered, 3 are of national or international concern, 6 are of conservation concern in the Northeastern U.S. region, and an additional 17 species are included due to concerns about declining populations or for other reasons. For additional regional, national, and international ranks see Appendix 3a and 3b.

Two fish federally-listed as endangered occur in the state of Maryland, one freshwater and one estuarine species. The endangered freshwater fish is the Maryland darter. This fish is Maryland's only endemic vertebrate. Because recent biological surveys have not recorded a specimen of this species, it may already be extinct (Boward et al. 1999). The Maryland darter is subject to the same stressors as other freshwater fish, however due to its restricted distribution, its chances of survival are much reduced. The existing management plan presents detailed status and distribution information, as well as information on the threats and the actions to abate these threats (USFWS 1985). The endangered shortnose sturgeon is an anadromous species and ranges along the Atlantic coast. One of this species' 19 population segments in North America occurs in the Chesapeake Bay. Human impacts, such as bridge construction and demolition, can have adverse effects on swimbladder fish such as the shortnose sturgeon (Litwiler 2001). Other human impacts and biological factors that cause population decline in shortnose sturgeons and conservation actions to protect the species are presented in DNR's conservation plan.

Brook trout and American eel are two freshwater species that have suffered drastic population declines in the state of Maryland. Once found in the millions, the population of brook trout has decreased to 300,000. The most important limiting factor to these fish is water temperature. Brook trout thrive in cool water, and their population decline is attributed to hot water runoff from roofs and roadsides, loss of trees along streams, and global warming. A brook trout management plan is being developed by DNR's Fisheries Service. The population of American eel has declined nearly 90%. Dams and other man-made barriers and dams have limited the eel's access to their historical spawning and nursery habitat and have caused an alarming decline in Maryland's eel population (Boward et al. 1999).

The dependence of GCN fish species on aquatic environments makes them vulnerable to negative inputs to streams, rivers, and estuaries. For example, run-off from roads, impervious surfaces, and agricultural and suburban areas can directly contaminate habitats for GCN species through inputs of road salt, oil, pesticides, herbicides, nutrients, and excessive sediments. In addition to direct impacts and those from immediately adjacent areas, the alteration of the landscape of the watershed is another important source of negative impacts. All moving water bodies are influenced by upstream inputs, and accumulations of toxins, sediments, and nutrients can be particularly acute in large rivers and estuaries. Any changes in pH, temperature, and turbidity from sources such as acid mine drainage, livestock grazing, recreational use, and urbanization can make habitats unsuitable for GCN fishes. Some GCN species, such as pearl dace and checkered sculpin, are particularly sensitive to temperature changes that occur when forest cover is removed, while others, such as glassy darter and ironcolor shiner, are excluded from areas when development increases siltation. Removal of trees from the watershed in general and especially from riparian areas can impact

stream temperature, increase sediment inputs, decrease instream woody debris and leaf litter, and alter tree root cover.

Groundwater withdrawals are an increasing threat to water levels in stream and river habitats in areas with high rates of development, and water withdrawal for irrigation is a threat in some areas of the state. Dams and other barriers to fish passage, such as road culverts, isolate populations and disrupt the connectivity that some species, such as American shad, require to remain a viable part of Maryland's fauna. Substrate and flow alterations, accompanied by the loss of prey and aquatic vegetation cover, through ditching and channelization threatens GCN species like mud sunfish. Pesticide applications, such as for mosquito control, can affect the aquatic prey species of many GCN fishes. Overharvest has particularly affected sturgeon and shad. Competition with species introduced for sport, mosquito control, or other means (e.g., bait bucket introductions, released pets) is an increasing concern.

Conservation Actions and Information Needs for GCN Fishes

For the effective conservation of GCN fishes, threats to aquatic habitats must be addressed at both local and landscape scales, from headwaters to large rivers and the Chesapeake Bay. Minimizing or eliminating stressors that affect key components of streams, rivers, and estuaries can come about through better stormwater management and reduction of impervious surfaces; reduction of acid mine drainage; upgrading wastewater treatment facilities; improved agricultural and forestry practices; reduction of pesticide use; and maintaining and improving riparian buffers. Careful planning to limit the location and extent of deforestation, urbanization, and nutrient inputs is needed to conserve functioning watersheds. Groundwater withdrawal should be limited and flows re-established through the restoration of natural processes. Maps of groundwater and hydrological systems could assist with determining potential impacts and planning restoration activities. Dams should continue to be removed wherever possible, stream blockages (including dams) should be improved, and work with highway departments should be increased to minimize the use of road culverts and encourage designs that reduce stream alterations and blockages.

More information on the seasonal movements and spatial requirements of GCN species, including anadromous fish, is needed to determine habitat requirements. Recreational management plans are important tools for conservation for some species, such as the brook trout management plan. Regulatory controls are needed to limit the establishment of non-natives and minimize their impact. Research on the impacts of competition between native and non-native species is also needed. Continued regulation is critical for the recovery of GCN shad and sturgeon populations. Reintroduction after habitat restoration has the potential to increase populations of some GCN species.

To restore Atlantic sturgeon, American shad, and hickory shad in the Chesapeake Bay, the DNR's Fisheries Service uses a combination of closed fishery, removal of barriers to spawning grounds, water quality improvements, and hatchery-produced fish. Information regarding threats and conservation actions for these fish can be found in the Fishery Management Plan for Atlantic Sturgeon by the Atlantic States Marine Fisheries Commission (ASMFC 1996), and the 1985 Interstate Fishery Management Plan for American Shad and

River Herring (ASMFC 1985, 1999). In 1989, a Chesapeake Bay Alosid Fishery Management Plan (FMP) was developed for American shad, hickory shad, alewife and blueback herring (CBP 1989a). The FMP defined problems associated with declining abundance, habitat loss and degradation, the potential for overfishing, and research and monitoring efforts.

Table 3.7 GCN Fishes of Maryland

Common Name	Scientific Name	State-listed	Federally-listed	S – Rank	G - Rank
American brook lamprey	<i>Lampetra appendix</i>	T		S1S2	G4
American shad	<i>Alosa sapidissima</i>	I		S3	G5
Atlantic sturgeon	<i>Acipenser oxyrinchus</i>		C	S1	G3
Banded sunfish	<i>Enneacanthus obesus</i>			S2	G5
Blackbanded sunfish	<i>Enneacanthus chaetodon</i>	T		S1	G4
Bluespotted sunfish	<i>Enneacanthus gloriosus</i>			S3S4	G5
Bowfin	<i>Amia calva</i>			S1?	G5
Bridle shiner	<i>Notropis bifrenatus</i>	E		SH	G5
Brook trout	<i>Salvelinus fontinalis</i>			S3S4	G5
Cheat minnow	<i>Pararhinichthys bowersi</i>	X		SX	G1G2Q
Checkered sculpin	<i>Cottus sp 7</i>			S1S2	G4Q
Comely shiner	<i>Notropis amoenus</i>	T		S2	G5
Flier	<i>Centrarchus macropterus</i>	T		S1S2	G5
Glassy darter	<i>Etheostoma vitreum</i>	T		S1S2	G4G5
Greenside darter	<i>Etheostoma blennioides</i>			S5	G5
Hickory shad	<i>Alosa mediocris</i>	I		S3	G5
Ironcolor shiner	<i>Notropis chalybaeus</i>	E		S1	G4
Johnny darter	<i>Etheostoma nigrum</i>			S3	G5
Least brook lamprey	<i>Lampetra aepyptera</i>			S4	G5
Logperch	<i>Percina caprodes</i>	T		S1S2	G5
Longnose gar	<i>Lepisosteus osseus</i>			S2?	G5
Longnose sucker	<i>Catostomus catostomus</i>	X		SH	G5
Maryland darter	<i>Etheostoma sellare</i>	E	E	SH	GH
Mottled sculpin	<i>Cottus bairdi</i>			S3S4	G5
Mud sunfish	<i>Acantharchus pomotis</i>	I		S2	G5
Northern hogsucker	<i>Hypentelium nigricans</i>			S5	G5

Common Name	Scientific Name	State-listed	Federally-listed	S – Rank	G - Rank
Pearl dace	<i>Margariscus margarita</i>	T		S1S2	G5
Redside dace	<i>Clinostomus elongatus</i>			SX	G4
Rosyside dace	<i>Clinostomus funduloides</i>			S5	G5
Shield darter	<i>Percina peltata</i>			S3	G5
Shortnose sturgeon	<i>Acipenser brevirostrum</i>	E	E	S1	G3
Silverjaw minnow	<i>Ericymba buccata</i>			S4	G5
Spotfin killifish	<i>Fundulus luciae</i>			S2?	G4
Stonecat	<i>Noturus flavus</i>	E		S1	G5
Stripeback darter	<i>Percina notogramma</i>	E		S1	G4
Striped shiner	<i>Luxilus chrysocephalus</i>	I		S1S2	G5
Swamp darter	<i>Etheostoma fusiforme</i>	I		S2	G5
Trout-perch	<i>Percopsis omiscomaycus</i>	X		SX	G5
Warmouth	<i>Lepomis gulosus</i>			S3?	G5
White catfish	<i>Ameiurus catus</i>			SU	G5

Invertebrates of Maryland

As a taxa group, Maryland's invertebrates are not as well studied as are the vertebrates. This is true at the regional and national scales as well, due to the vast number of species and the complexities of the ecological communities of which they are an integral part. The status of some species, however, is known well enough for them to be recognized as in need of further study (the vast majority of them) or to be listed as endangered, threatened, or in need of conservation.

Because Maryland has marine, estuarine, freshwater and terrestrial environments, the invertebrate fauna of Maryland are diverse and include thousands of species ranging from dragonflies and damselflies, butterflies and moths, to freshwater mussels and benthic marine invertebrates.

Invertebrates in Maryland represent many taxonomic groups, including planarians, sponges, worms, mollusks, and arthropods (e.g., crustaceans, insects, arachnids). Several species are of high economic importance, either as commercially valuable species or as pest species. Commercially important species include the blue crab, several clam species and American oyster, which are collaboratively managed by DNR's Fisheries Service to strive for healthy,

sustainable populations. The state's populations of horseshoe crab, blue crab and oysters have existing fishery management plans (CBP 1994c 1998b, 2004b). Oyster populations are only a small fraction of their historical abundance and the introduction of the Asian oyster is now being debated to restore an oyster population into the Chesapeake Bay. Blue crabs have the highest monetary value of any commercial fishery in the Chesapeake Bay, with average commercial landings of 86 million pounds a year and recreational landings of 22 million pounds in 1988 and 41 million pounds in 1983 (CBP 1998b). Horseshoe crabs are also commercially valuable, with Maryland catches making up 23-78% of the northeast region's landings along the Atlantic coast since 1980 (CBP 1994c).

Other invertebrate species serve as biological indicators for environmental health. More than 350 types of benthic macroinvertebrates are found in Maryland streams, allowing DNR to utilize an Index of Biotic Integrity for benthic macroinvertebrate species (plus another for fish) to assess the health of stream communities (Boward et al. 1999). The number of pollution-sensitive benthic macroinvertebrate taxa is another measure that DNR uses to assess stream health. Several mayflies, stoneflies and caddisflies, collectively called EPT for their taxonomic orders (Ephemeroptera, Plecoptera, and Trichoptera), are monitored to indicate water quality and/or physical habitat degradation of Maryland's streams (Boward et al. 1999). The benthic communities of the Coastal Bays and their associated tidal streams similarly have served as biological indicators for the health of those estuaries (DNR 2004d).

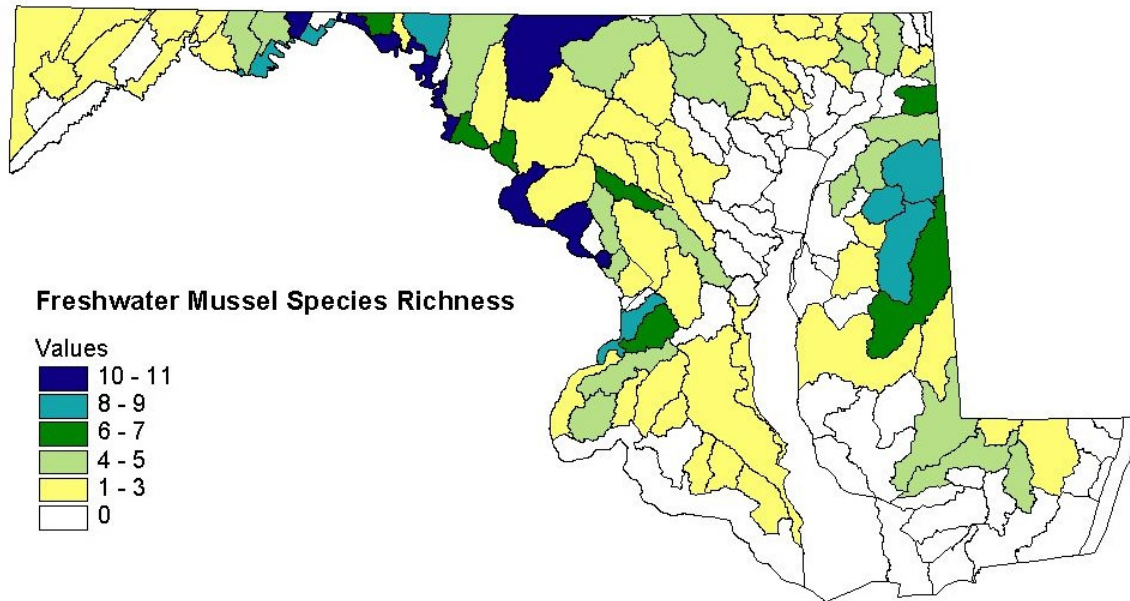
Some insects are considered pests. The Maryland Department of Agriculture has control programs in place to address agricultural and forest pest species. The gypsy moth, southern pine beetle, emerald ash borer, Asian longhorned beetle and pine shoot beetle are all insect pest species that the Department of Agriculture monitors and tries to suppress. The Department also controls mosquitoes to prevent the spread of mosquito-borne disease in humans, pets and livestock.

The paucity of invertebrate information is an important statement to the limitations of our knowledge and ability to fully or fairly represent them in the Maryland Wildlife Diversity Conservation Plan. Although the population status for several invertebrate taxa and for some rare species is known, little is known for the vast majority of invertebrates in Maryland. For this reason, this plan takes a coarse-filter approach to invertebrate conservation, using available distribution and health of natural vegetative communities and habitats as surrogates for species lacking status information. For example, many butterflies require one or a few species of food plants in order to complete their life cycles. To take a well-known example, the Monarch butterfly lays its eggs on milkweeds in the genus *Asclepias*. Preserve habitats with milkweeds and this part of the butterfly's life cycle will be secure. For many odonates (dragonflies and damselflies), part of their life cycle is completed in the clean waters of flowing streams. Maintaining clean and free-flowing waters will enhance odonate populations.

Nationally and regionally, many freshwater mussel species are in danger of extinction (Williams et. al. 1993). Six of Maryland's 16 native freshwater mussel species are state-listed due to their rarity. Additional surveys and long-term monitoring are needed to fully determine the distribution and abundance of these freshwater mussels; however, surveys to

date have revealed the distribution shown in Figure 3.6. Baseline population status and life history information is needed to establish effective conservation actions. The status and conservation of the federally-endangered dwarf wedge mussel is covered by an existing recovery plan (USFWS 1993a).

Figure 3.6 Distribution of Maryland's Freshwater Mussels by watershed (Source: DNR NHP)



There is a need to assess abundance and distribution of non-harvested benthic estuarine and marine macroinvertebrates. As with other invertebrate species discussed above, a coarse-filter habitat approach will be necessary to manage for these species until population information is gathered.

GCN Invertebrates of Maryland

Maryland DNR lists 245 species of invertebrates as in greatest conservation need in the state. This list (Table 3.8) includes 5 species of flatworm, 14 freshwater mussels, 9 snails, 27 freshwater crustaceans, 1 marine arthropod, 3 spiders, and 186 species within several orders of insects: Collembola (1 species), Coleoptera (23), Diptera (1), Ephemeroptera (1), Homoptera (2), Lepidoptera (58), and Odonata (100). Most of these species are so poorly known that they cannot be classified as endangered or threatened, only in need of further study, but about 10 percent of the insects are studied well-enough to know they merit conservation status.

The GCN invertebrate list includes 61 state-listed species, of which 42 are listed as threatened or endangered; 27 are of national or international concern; and 5 are of conservation concern in the Northeastern U.S. region. Five species are federally-listed, including the endangered dwarf wedge mussel, American burying beetle, Mitchell's satyr

(butterfly) and two threatened tiger beetles. For additional regional, national, and international ranks see Appendix 3a and 3b.

Even nationally, endangered species of invertebrates are disproportionately underrepresented in species conservation efforts. As a result, many scientists call for an ecosystem-level approach to provide conservation for endangered invertebrates, while collecting needed information about the diversity, abundance and distribution of these species. Eventually population data would allow species-based actions to be incorporated into management plans to protect specific endangered invertebrate species (Black et al. 2001).

Maryland's GCN invertebrates include species that are impacted by a wide range of threats to a variety of terrestrial and aquatic microhabitats. Freshwater mussels, crustaceans, odonates, aquatic macroinvertebrates, and spring amphipods are especially sensitive to contamination of water sources through acid mine drainage; sedimentation and water chemistry alteration from development, agriculture, and forest cover removal; and non-target effects of pesticide use for mosquito control. In addition, the dependence of some GCN mussels on specific fish hosts to complete their life cycles multiplies the effect of threats to aquatic environments. Terrestrial insects, including moths, butterflies, and forest beetles, may be impacted by the incompatible or excessive use of insecticides to control pest species such as gypsy moths and crop pests. GCN tiger beetles' dependence on open, sandy areas makes them vulnerable to a disruption of natural processes, such as shoreline cliff erosion, and to disturbance by recreational uses, development, and the use of heavy equipment and site preparation for logging.

The cave and aquifer habitats of a number of GCN isopods and amphipods are affected by groundwater pollution and hydrologic disturbances that are usually associated with development. These and other cave organisms (spiders, springtails, and planaria) are also affected by direct disturbance from spelunkers. GCN land snails are affected by air pollution, acid rain, and habitat drying from forest removal and fragmentation. Vernal pools, the only habitat for several GCN beetles including the recently-described Seth forest water scavenger beetle, may be drained or degraded through development, timber harvest activities, and gypsy moth control. Other wetlands are important for GCN dragonflies, and the loss of beaver impoundments, overgrazing, and ditching and draining of marshes and wetlands for agriculture, mosquito control, and development impact these species. The dependence of GCN butterfly and moth larvae on specific host plants makes them vulnerable to plant loss through extensive deer browsing, displacement of native species by exotic invasives, and control of plant species and incompatible mowing regimes along roadsides and powerlines. Overcollection is a particular concern for some butterfly species and also horseshoe crab.

Conservation Actions and Information Needs for GCN Invertebrates

Of all the taxonomic groups that comprise Maryland's wildlife, the invertebrate group includes the most species for which basic biological information is needed. Information on host plant preferences and impacts of invasive plants on butterflies and moths, fish hosts for mussels, microhabitat preferences and tolerances, and the impacts of pest control on non-target species are especially needed to determine effective conservation actions. Survey techniques for deepwater mussels and lesser known groups, and even identification of GCN

organisms can be a challenge. Recovery plans for several federally-listed species, such as dwarf wedge mussel (USFWS 1993a) and northeastern beach and puritan tiger beetles (USFWS 1993b, 1994), and a regional conservation strategy for horseshoe crab can assist in determining conservation actions for these species in Maryland.

Aquatic habitats for GCN invertebrates require protection through a reduction or mitigation of acid mine drainage, impervious surfaces, deforestation, and inputs of nutrients, pesticides, and herbicides near water bodies. Pest control strategies that are incompatible with GCN species should be avoided. Human disturbance of open sand habitats, vernal pools, and cave environments, as well as overcollection, can be limited by education and exclusion from sensitive areas. Restoration of open and early successional habitats and of natural processes, such as fire frequency and cliff erosion, is needed to maintain and recover GCN invertebrates that are limited to such habitats. Degradation of forested habitats can be minimized by limiting forest fragmentation, buffering vernal pools, controlling deer populations and invasive plants, and maintaining critical microhabitats. State and local wetland laws should be appended as needed for greater protection, and the restoration of wetland habitats through beaver impoundments and plugging ditches can help to address wetland losses.

Table 3.8 GCN Invertebrates of Maryland

Common Name	Scientific Name	State-listed	Federally-listed	S – Rank	G - Rank
Planaria					
A planarian	<i>Phagocata virilis</i>			S1	G?
A planarian	<i>Planaria dactyligera</i>			S2	G?
A planarian	<i>Procotyla typhlops</i>	E		S1	G1G2
A planarian	<i>Sphalloplana sp 1</i>			S1S2	G?
Hoffmaster's cave planarian	<i>Sphalloplana hoffmasteri</i>	E		S1	G2G3
Molluscs					
Alewife floater	<i>Anodonta implicata</i>			S3	G5
Angular disc	<i>Discus catskillensis</i>			S1	G3G5
Appalachian spring snail	<i>Fontigens bottimeri</i>			S2	G2
Atlantic spike	<i>Elliptio producta</i>			S2S3	G4Q
Bear creek slitmouth	<i>Stenotrema simile</i>			SU	G?
Blue ridge spring snail	<i>Fontigens orolibas</i>	E		S1	G2G3
Brook floater	<i>Alasmidonta varicosa</i>	E		S1	G3
Cherrydrop snail	<i>Hendersonia occulta</i>	I		S2	G4
Creeper	<i>Strophitus</i>	I		S2	G5

Common Name	Scientific Name	State-listed	Federally-listed	S – Rank	G - Rank
	<i>undulatus</i>				
Cylindrically-ornate wood snail	<i>Vertigo ventricosa</i>			SU	G3G4
Dwarf wedge mussel	<i>Alasmidonta heterodon</i>	E	E	S1	G1G2
Eastern lampmussel	<i>Lampsilis radiata</i>			SU	G5
Eastern pondmussel	<i>Ligumia nasuta</i>			SU	G4G5
Green floater	<i>Lasmigona subviridis</i>	E		S1	G3
Northern lance	<i>Elliptio fisheriana</i>			S3	G4
Paper pondshell	<i>Utterbackia imbecillis</i>			S3	G5
Rader's snail	<i>Glyphyalinia raderi</i>	X		SH	G2
Spruce knob threetooth	<i>Triodopsis picea</i>			S1	G3
Striped whitelip	<i>Webbhelix multilineata</i>			S1	G?
Tidewater mucket	<i>Leptodea ochracea</i>			SU	G4
Triangle floater	<i>Alasmidonta undulata</i>	E		S1	G4
Yellow lampmussel	<i>Lampsilis cariosa</i>	X		S1	G3G4
Yellow lance	<i>Elliptio lanceolata</i>			SU	G2G3
Non-Insect Arthropods					
A crayfish	<i>Cambarus acuminatus</i>			S3	G4
A crayfish	<i>Orconectes obscurus</i>			S3	G5
A cyclopoid copepod	<i>Diacyclops palustris</i>			SU	G?
A harpacticoid copepod	<i>Attheyella spinipes</i>			SU	G?
Allegheny cave amphipod	<i>Stygobromus allegheniensis</i>	I		S2S3	G4
An amphipod	<i>Stygobromus sp 6</i>			S1	G?
An entocytherid ostracod	<i>Ankylocythere tridentata</i>			SU	G?
An entocytherid ostracod	<i>Dactylocythere scotos</i>			S1	G?
An isopod	<i>Caecidotea sp 1</i>			S1	G1
An isopod	<i>Caecidotea sp 2</i>			S1	G?

Common Name	Scientific Name	State-listed	Federally-listed	S – Rank	G - Rank
An isopod	<i>Caecidotea sp 3</i>			S1	G3
An isopod	<i>Caecidotea sp 4</i>			S1	G?
An isopod	<i>Caecidotea sp 5</i>			S1	G?
An isopod	<i>Caecidotea sp 6</i>			S2	G?
Appalachian cave spider	<i>Porhomma cavernicola</i>			S2	G4G5
Barrelville amphipod	<i>Stygobromus sp 5</i>			S1	G?
Biggers' cave amphipod	<i>Stygobromus biggersi</i>	E		S1	G2G4
Dearolf's cave amphipod	<i>Crangonyx dearolfi</i>	E		S1	G2G3
Franz's cave amphipod	<i>Stygobromus franzi</i>	I		S2S3	G2G3
Franz's cave isopod	<i>Caecidotea franzi</i>	E		S1	G2G3
Greenbrier cave amphipod	<i>Stygobromus emarginatus</i>	E		S1	G3
Horseshoe crab	<i>Limulus polyphemus</i>			S?	G?
Pizzini's amphipod	<i>Stygobromus pizzinii</i>			S1	G2G4
Potomac amphipod	<i>Stygobromus tenuis potomacus</i>			S3	G4T3T4 Q
Price's cave isopod	<i>Caecidotea pricei</i>			S3	G3G4
Red-legged purse-web spider	<i>Sphodros rufipes</i>			S1S2	G4
Roundtop amphipod	<i>Stygobromus sp 14</i>			S1	G?
Shenandoah cave amphipod	<i>Stygobromus gracilipes</i>	E		S1	G2G4
Snivelys cave spider	<i>Oreonetides sp 1</i>			SU	G?
Tenuis amphipod	<i>Stygobromus tenuis tenuis</i>			SU	G4G5T2 T3Q
Tidewater amphipod	<i>Stygobromus indentatus</i>			S1	G3
Insects - Beetles					
A cave beetle	<i>Pseudanophthalmus sp 15</i>			S1	G1
A coccinellid beetle	<i>Nephus gordonii</i>			SU	G?

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A dytiscid beetle	<i>Hopierius planatus</i>			S2	G?
A hydrophilid beetle	<i>Hydrochara occulta</i>			SU	G?
A hydrophilid beetle	<i>Sperchopsis tessellates</i>			S2	G?
A lampyrid firefly	<i>Photuris bethaniensis</i>			SP	G1?
A tiger beetle	<i>Cicindela abdominalis</i>	E		S1	G5
A tiger beetle	<i>Cicindela ancocisconensis</i>	E		S1	G3
A tiger beetle	<i>Cicindela purpurea</i>			S3	G5
A tiger beetle	<i>Cicindela scutellaris</i>			S3	G5
A tiger beetle	<i>Cicindela splendida</i>			S3	G5
A tiger beetle	<i>Cicindela unipunctata</i>			S3	G4
American burying beetle	<i>Nicrophorus americanus</i>	X	E	SX	G2G3
Big sand tiger beetle	<i>Cicindela formosa</i>			SU	G5
Giant stag beetle	<i>Lucanus elephas</i>			S1	G3G5
Green-patterned tiger beetle	<i>Cicindela patruela</i>	E		S1	G3
Little white tiger beetle	<i>Cicindela lepida</i>	E		S1	G4
Northeastern beach tiger beetle	<i>Cicindela dorsalis dorsalis</i>	E	T	S1	G4T2
Puritan tiger beetle	<i>Cicindela puritana</i>	E	T	S1	G1G2
Schwarz' diving beetle	<i>Laccophilus schwarzi</i>			SX	G?
Seth forest water scavenger beetle	<i>Hydrochus spangleri</i>	E		S1	G1
Six-banded longhorn beetle	<i>Dryobius sexnotatus</i>	E		S1	G?
White tiger beetle	<i>Cicindela dorsalis media</i>	E		S1	G4T4
Insects – Butterflies and Moths					
A geometrid moth	<i>Cyclophora nanaria</i>			S1?	G5
A noctuid moth	<i>Apamea mixta</i>			S1	GU
A noctuid moth	<i>Hadena ectypa</i>			SU	G3G4

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A noctuid moth	<i>Meropleon titan</i>			SU	G2G4
A noctuid moth	<i>Zale curema</i>			S1?	G3G4
American chestnut nepticulid moth	<i>Ectoedemia castaneae</i>			SH	GH
Appalachian blue	<i>Celastrina neglectamajor</i>			S3S4	G4
Atlantis fritillary	<i>Speyeria atlantis</i>	T		S1	G5
Baltimore checkerspot	<i>Euphydryas phaeton</i>			S3	G4
Bog copper	<i>Lycaena epixanthe</i>	E		S1	G4G5
Carolina satyr	<i>Hermeuptychia sosybius</i>			S1S3	G5
Chermock's mulberry wing	<i>Poanes massasoit chermocki</i>	E		S1	G4T1
Chestnut clearwing moth	<i>Synanthedon castaneae</i>			SX	G3G5
Cobweb skipper	<i>Hesperia metea</i>			S3	G4G5
Compton tortoiseshell	<i>Nymphalis vaualbum</i>	E		S1B	G5
Cypress sphinx moth	<i>Isoparce cupressi</i>			SU	G4
Dion skipper	<i>Euphyes dion</i>			S3	G4
Dotted skipper	<i>Hesperia attalus slossonae</i>			SH	G3G4T3
Dusky azure	<i>Celastrina ebenina</i>	E		SH	G4
Early hairstreak	<i>Erora laeta</i>	E		S1	G3G4
Edwards' hairstreak	<i>Satyrium edwardsii</i>	E		S1	G4
Frosted elfin	<i>Incisalia irus</i>	E		S1	G3
Giant swallowtail	<i>Papilio cresphontes</i>	I		S2	G5
Golden-banded skipper	<i>Autochton cellus</i>	X		SH	G4
Gray comma	<i>Polygonia progne</i>			S1S3	G5
Great purple hairstreak	<i>Atlides halesus</i>	T		S1S2	G5
Harris's checkerspot	<i>Chlosyne harrisii</i>	T		S2	G4
Hessel's hairstreak	<i>Mitoura hesseli</i>	X		SH	G3G4
Hickory hairstreak	<i>Satyrium caryaevorum</i>	E		S1	G4
Hoary elfin	<i>Callophrys polios</i>			S1	G5
Indian skipper	<i>Hesperia sassacus</i>			S3	G5

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King's hairstreak	<i>Satyrium kingi</i>	E		S1	G3G4
Long dash	<i>Polites mystic</i>			S3	G5
Marbled underwing	<i>Catocala marmorata</i>			SH	G3G4
Mitchell's satyr	<i>Neonympha mitchellii</i>		E	SR	G1G2
Mottled duskywing	<i>Erynnis martialis</i>	E		S1	G3G4
Northern crescent	<i>Phyciodes cocyta</i>			SP	G5
Northern hairstreak	<i>Fixsenia ontario</i>	E		S1S2	G4T4
Northern metalmark	<i>Calephelis borealis</i>	T		S2	G3G4
Olympia marble	<i>Euchloe olympia</i>	I		S2	G4G5
Palamedes swallowtail	<i>Papilio palamedes</i>	E		S1	G5
Pepper and salt skipper	<i>Amblyscirtes hegon</i>	I		S2	G5
Persius duskywing	<i>Erynnis persius persius</i>			SH	G5T2T3
Phleophagan chestnut nepticulid moth	<i>Ectoedemia phleophaga</i>			SH	GH
Pine barrens zanclognatha	<i>Zanclognatha martha</i>			S1S3	G4
Pink-edged sulphur	<i>Colias interior</i>			S1	G5
Precious underwing	<i>Catocala pretiosa pretiosa</i>			SH	G4T2T3
Rare skipper	<i>Problema bulenta</i>	T		S1	G2G3
Regal fritillary	<i>Speyeria idalia</i>	X		SH	G3
Seaside goldenrod stem borer	<i>Papaipema duovata</i>			SU	G4
Silver-bordered fritillary	<i>Boloria selene</i>			S3	G5
Silvery blue	<i>Glaucopsyche lygdamus</i>	I		S2	G5
Southern grizzled skipper	<i>Pyrgus wyandot</i>	E		S1	G2
Tawny crescent	<i>Phyciodes batesii batesii</i>	X		SH	G4T1
The buckmoth	<i>Hemileuca maia maia</i>			SU	G5T5

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Three-horned moth	<i>Pachypolia atricornis</i>			SH	G3G4
Two-spotted skipper	<i>Euphyes bimacula</i>	E		S1	G4
West virginia white	<i>Pieris virginiensis</i>			S3	G3G4
Insects – Dragonflies and Damselflies					
A snaketail	<i>Ophiogomphus sp 1</i>			S1	G?
Allegheny river cruiser	<i>Macromia alleghaniensis</i>			S2	G4
Allegheny snaketail	<i>Ophiogomphus incurvatus</i>			S2	G3
Amber-winged spreadwing	<i>Lestes eurinus</i>			S3	G4
American emerald	<i>Cordulia shurtleffi</i>			S3	G5
Arrowhead spiketail	<i>Cordulegaster obliqua</i>			S2	G4
Atlantic bluet	<i>Enallagma doubledayi</i>			SH	G5
Attenuated bluet	<i>Enallagma daeckii</i>			S3	G4
Aurora damsel	<i>Chromagrion conditum</i>			S3S4	G5
Azure bluet	<i>Enallagma aspersum</i>			S3S4	G5
Band-winged meadowhawk	<i>Sympetrum semicinctum</i>			S3	G5
Bar-winged skimmer	<i>Libellula axilena</i>			S3	G5
Beaverpond baskettail	<i>Epitheca canis</i>			S3	G5
Big bluet	<i>Enallagma durum</i>			S3	G5
Black-tipped darner	<i>Aeshna tuberculifera</i>			S2	G4
Blackwater bluet	<i>Enallagma weewa</i>			S1	G5
Blue-faced meadowhawk	<i>Sympetrum ambiguum</i>			S3S4	G5
Brown spiketail	<i>Cordulegaster bilineata</i>			S2	G5
Burgundy bluet	<i>Enallagma dubium</i>			S1	G5
Canada darner	<i>Aeshna canadensis</i>			S2	G5
Chalk-fronted skimmer	<i>Libellula julia</i>			S2	G5
Cherry-faced	<i>Sympetrum</i>			S2	G5

Common Name	Scientific Name	State-listed	Federally-listed	S – Rank	G - Rank
meadowhawk	<i>internum</i>				
Cobra clubtail	<i>Gomphus vastus</i>			S3	G5
Comet darner	<i>Anax longipes</i>			S3	G5
Common sanddragon	<i>Progomphus obscurus</i>			S3	G5
Crimson-ringed whiteface	<i>Leucorrhinia glacialis</i>			S1	G5
Cyrano darner	<i>Nasiaeschna pentacantha</i>			S3	G5
Delta-spotted spiketail	<i>Cordulegaster diastatops</i>			S3	G5
Dot-tailed whiteface	<i>Leucorrhinia intacta</i>			S3	G5
Eastern red damsel	<i>Amphiagrion saucium</i>			S3	G5
Eastern ringtail	<i>Erpetogomphus designatus</i>			S2	G5
Elfin skimmer	<i>Nannothemis bella</i>			S1	G4
Elusive clubtail	<i>Stylurus notatus</i>			SU	G3
Emerald spreadwing	<i>Lestes dryas</i>			SH	G5
Faded pennant	<i>Celithemis ornata</i>			S1	G5
Fine-lined emerald	<i>Somatochlora filosa</i>			S2	G5
Four-spotted pennant	<i>Brachymesia gravida</i>			S3S4	G5
Golden-winged skimmer	<i>Libellula auripennis</i>			S3	G5
Gray petaltail	<i>Tachopteryx thoreyi</i>			S2	G4
Great spreadwing	<i>Archilestes grandis</i>			S3	G5
Green-faced clubtail	<i>Gomphus viridifrons</i>			S1	G3
Green-striped darner	<i>Aeshna verticalis</i>			S2	G5
Hagen's bluet	<i>Enallagma hageni</i>			S3S4	G5
Harlequin darner	<i>Gomphaeschna furcillata</i>			S3	G5
Harpoon clubtail	<i>Gomphus desertus</i>			S1	G4
Hudsonian whiteface	<i>Leucorrhinia hudsonica</i>			S1	G5
Lance-tipped	<i>Aeshna constricta</i>			SH	G5

Common Name	Scientific Name	State-listed	Federally-listed	S – Rank	G - Rank
darner					
Laura's clubtail	<i>Stylurus laurae</i>			S2	G4
Least clubtail	<i>Stylogomphus albistylus</i>			S3S4	G5
Little blue dragonlet	<i>Erythrodiplax minuscula</i>			S1	G5
Lyre-tipped spreadwing	<i>Lestes unguiculatus</i>			SH	G5
Mantled baskettail	<i>Epithea semiaquea</i>			SH	G4
Marsh bluet	<i>Enallagma ebrium</i>			SH	G5
Martha's pennant	<i>Celithemis martha</i>			S2	G4
Midland clubtail	<i>Gomphus fraternus</i>			S2	G5
Mocha emerald	<i>Somatochlora linearis</i>			S3S4	G5
Northern pygmy clubtail	<i>Lanthus parvulus</i>			S1	G4
Ocellated darner	<i>Boyeria grafiana</i>			S1	G5
Pale bluet	<i>Enallagma pallidum</i>			SH	G4
Petite emerald	<i>Dorocordulia lepida</i>			SH	G5
Piedmont clubtail	<i>Gomphus parvidens</i>			SH	G4
Rainbow bluet	<i>Enallagma antennatum</i>			S1	G5
Rapids clubtail	<i>Gomphus quadricolor</i>			S1	G3G4
River jewelwing	<i>Calopteryx aequabilis</i>			S1	G5
Riverine clubtail	<i>Stylurus amnicola</i>			SH	G4
Robust baskettail	<i>Epithea spinosa</i>			S1S2	G4
Royal river cruiser	<i>Macromia taeniolata</i>			S3	G5
Russet-tipped clubtail	<i>Stylurus plagiatus</i>			S3	G5
Rusty snaketail	<i>Ophiogomphus rupinsulensis</i>			S2	G5
Sable clubtail	<i>Gomphus rogersi</i>	E		S1	G4
Sedge sprite	<i>Nehalennia irene</i>			S3	G5
Seepage dancer	<i>Argia bipunctulata</i>			S3	G4
Selys' sunfly	<i>Helocordulia selysii</i>			S2	G4
Skillet clubtail	<i>Gomphus</i>			SH	G3

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	<i>ventricosus</i>				
Ski-tailed emerald	<i>Somatochlora elongata</i>			S1	G5
Slender bluet	<i>Enallagma traviatum</i>			S3	G5
Smoky rubyspot	<i>Hetaerina titia</i>			SH	G5
Southern pygmy clubtail	<i>Lanthus vernalis</i>			S1	G4
Southern sprite	<i>Nehalennia integricollis</i>			S1S2	G5
Sparkling jewelwing	<i>Calopteryx dimidiata</i>			SH	G5
Sphagnum sprite	<i>Nehalennia gracilis</i>			S2	G5
Spine-crowned clubtail	<i>Gomphus abbreviatus</i>			SH	G3G4
Splendid clubtail	<i>Gomphus lineatifrons</i>			SH	G4
Spotted spreadwing	<i>Lestes congener</i>			S3	G5
Spring blue darner	<i>Aeshna mutata</i>	E		S1	G3G4
Stripe-winged baskettail	<i>Epitheca costalis</i>			S1	G4
Stygian shadowdragon	<i>Neurocordulia yamaskanensis</i>			S2	G5
Superb jewelwing	<i>Calopteryx amata</i>			S2	G4
Sweetflag spreadwing	<i>Lestes forcipatus</i>			S3	G5
Taper-tailed darner	<i>Gomphaeschna antilope</i>			S2	G4
Tiger spiketail	<i>Cordulegaster erronea</i>			S2	G4
Treetop emerald	<i>Somatochlora provocans</i>			S1	G4
Tule bluet	<i>Enallagma carunculatum</i>			SH	G5
Turquoise bluet	<i>Enallagma divagans</i>			S3S4	G5
Uhler's sundragon	<i>Helocordulia uhleri</i>			S3	G5
Vesper bluet	<i>Enallagma vesperum</i>			S3	G5
White corporal	<i>Libellula exusta</i>			S1	G4
White-faced	<i>Sympetrum</i>			S3	G5

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meadowhawk	<i>obtrusum</i>				
Yellow-sided skimmer	<i>Libellula flavida</i>			S2	G5
Zebra clubtail	<i>Stylurus scudderi</i>			S1	G4
Insects – Other Orders					
A cicadellid leafhopper	<i>Chlorotettix sp 1</i>			SU	G?
Crabtree cave springtail	<i>Arrhopalites sp 1</i>			SU	G?
Eastern sedge barrens planthopper	<i>Limotettix minuendus</i>			S1	G1
Pitcher-plant mosquito	<i>Wyeomyia smithii</i>			S2	G5
Walker's tusked sprawler	<i>Potamanthus walkeri</i>			SU	G5